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# MANUAL

OF

# ORTHOPEDIC SURGERY.

## A TREATISE ON DEFORMITIES AND DISEASES OF JOINTS AND BONES.

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BY

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## PREFACE.

It is not the object of the author to treat exhaustively the subject of Orthopedic Surgery. This book is intended for the busy practitioner as an aid in diagnosis and treatment, and for the student who finds little time to pursue the larger works. It is thought an advantage to group cuts illustrating similar conditions in order that comparison may be more easily made. The sole aim has been to consider as much in one sentence as possible, to eliminate speculation, and to present what the author believes the most modern and accepted views of pathology and treatment.

The author is indebted to Sayre, Bradford and Lovett, Young, Ridlon, Tubby, Schreiber, Reeves and the members of the American Orthopedic Association, for he has freely culled from the transactions of this Association, and from the works of the gentlemen named, in arranging the following pages.

S. L. McCURDY,
515 Penn Avenue.

*Pittsburgh, Pa., November 1, 1898.*

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# INTRODUCTION.

The accepted definition of Orthopedic Surgery is "That department of general medicine and surgery which has to do with the prevention, the mechanical and operative treatment of chronic and progressive deformities." It is preventive when an early diagnosis is made of a beginning hip or other tubercular bone disease, and retaining apparatus is applied and the patient recovers with a minimum of deformity. It is also a preventive when braces are applied, and treatment instituted in paralytic diseases, which if left without treatment would result in deformity. The mechanical and operative treatment are corrective measures used when cases are seen when deformity already exists.

Chronic deformity means any variety of distortion or displacement which, so far as the patient is concerned, is stationary or permanent, and progressive deformity is one which, without proper treatment, grows progressively worse. Deformities may be congenital or acquired. The lesion may be in the skeleton as a congenital defect or as result of bone disease during life, or the lesion may be in the muscular or nervous system. Deformity may result from impaired nutrition or from blood changes. Finally, chronic deformity may result from an injury, either of the brain, cord, or peripheral nerves, or the bone, of the muscular system, or of joints.

**Orthopedic Surgery,** as a specialty, is in its infancy, and of the pioneers, Davis, Taylor and Sayre; Davis alone is dead. During a generation it has grown until now many of the large cities have a specialist.

In Boston, New York and Philadelphia it is in the front rank as a specialty. In addition to the treatment of crippled children in hospitals and dispensaries, their subsequent cure has been crystalized into a special charity in the form of convalescent homes, and industrial schools, notably in Boston and Philadelphia. Of all varities of diseases none so much demand pure air and outdoor exercise as children suffering with tubercular bone and joint diseases. The reason they succumb to the disease is that the bacillus of tuberculosis finds a condition of reduced vitality and destroys the cell elements of the body. Recovery cannot take place so long as this condition is unchanged. Along with mechanical means, fresh air and good food must go hand in hand after acute stage is passed; all of these children would do far better, if removed from the crowded districts to the more airy suburbs where the per centum of bacteria found in the air is reduced a thousand fold.

Introductory to a consideration of special subjects it might be well to call attention to the subject in general.

**Examination.** In studying deformity a most thorough examination must be made of the nude body, and the two sides compared. This is done by (1), inspection; (2), palpation; (3), manipulation; (4), measurement, and (5), auscultation. (1). By **inspecting** the patient, the attitude may be studied. This may be done while the patient is lying, standing, walking and stooping. Every aspect must be observed.

In typical cases the trained eye of the specialist can tell when he sees cripples on the street what the trouble is, or when a new case walks into his office a diagnosis is made before a question is asked. All cases are not typical, however, and during the first stage it is only after every means has been used that a positive opinion can be given. By inspection, the posture of the body, or the head, or the legs may be studied. Atrophy of the muscles, tumefactions or distortions of joints, angles of bones, curvatures of the spine are noted and estimated. Color of the parts and dilated veins are observed. (2). By **Palpation** the muscles are found to be rigid or flabby, the joint is found rigid, relaxed, hard, soft or brawny, enlarged glands are felt, bony prominences are outlined and displacements made out. (3). By **manipulation** it can be determined whether the joint is rigid, or limited in range of motion, or is in a healthy condition by eliciting crepitus, and as to whether the bones are in a normal angle, or position (4). **Mensuration** is a most valuable means of determining definite amount of deformity, and by keeping records and comparing them from time to time it can be determined whether the case is improving or growing progressively worse. Definite landmarks are recognized and used by the specialist. The *anterior superior spine* of the ilium is the landmark for the thigh, and the external maleolus for the leg. The *acromian process* is used in making measurements of the upper extremity. The *supra-sternal* notch for the anterior portion of the thorax and abdomen. The *vertebra prominens* is the landmark for the spine. From it observations, lines, and measurements of the thorax, spine and pelvis are made. So also may estimates

be made of the cervical region and of the head. (5). **Auscultation.** Five sounds are recognized by B. W. Richardson. (1), Simple dry friction sound; (2), Dry grating sound; (3), Coarse grating sound; (4), Moist crepitant sound; (5), Coarse crepitant sound. In inspecting and measuring patients, in making a diagnosis and in taking measures for braces, it is quite a help to mark on the skin, and a pencil called a *dermatograph*, is made for this purpose and answers admirably.

The orthopedic instruments of precision and equipment for making records may be given as follows:- (1), Tape line 6 feet long, (metric and inches); (2), Lead tape and wire; (3), Dermatograph; (4), Goniometer; (5), Record blanks, 8 by 15 inches; (6), Card board for making outlines; (7), Screw driver; (8), Twisters; (Fig. A.) (9), Plaster knife, scissors and saw.

FIG. A.

**Records** must be kept of all cases if an estimate of the progress of the case is to be made. These records are made by taking traces of the distorted extremity on paper as large as the part to be traced and by measuring as suggested, the figures being entered on the record blanks. For taking outlines of spinal curvatures or distortions nothing is better than a lead tape or lead wire. This is bent to conform to the curvature and is then laid on a record blank and the outline traced with

a pencil. The tracings may be made on stiff card board and this is cut out as is done in some of the large Orthopedic Hospitals. The one definite and most satisfactory method of keeping records is by photography. This is accurate, provided positions are made the same at various times.

**Diagnosis.** The prevalent notion that all joint diseases, or at least a majority of them are rheumatic, is such a fixed principle in the mind of the Doctor, and has been so forcibly brought out in teachings of the past, before the bacillus of tuberculosis was discovered, that it is a most difficult matter to re-educate the mind and re-construct fixed views and opinions. It is rare to find a graduate during the past ten years, who does not have a thorough appreciation of the importance of the bacillus of tuberculosis as a cause of all the serious bone and joint diseases. The practitioners of less recent training, are more likely to mistake tuberculosis, and other bone and joint diseases, for rheumatism, since little was known, regarding this, and other diseases, as osteo-myelitis, osteo-sarcoma, the arthropathies associated with pheumonia and other acute infectious diseases, and arthropathies and distortions associated with lesions of the nervous system, until more recent investigations had differentiated them as separate and distinct conditions.

**Prognosis.** The ultimate outcome in all cases of bone and joint diseases, and in cases of paralysis and other diseases of the skeleton, muscular and nervous system, depends upon the time at which proper treatment is instituted. The general practitioner is liable to err in two ways. (1) In paying too little attention to the complaints of children who have, to them, obscure

symptoms, and (2) if serious disease of the skeleton is suspected, to place it on treatment and continue to treat it until hopeless deformity exists, when he refers him to the specialists, at a time when it is almost, if not impossible, to restore the distortion to a normal condition. The cripple of the family is cast aside as hopeless by the parents, because the family physician says that nothing can be done, but if there is one duty due these cripples, it is that they be given the benefit of treatment by a specialist, thoroughly prepared in Orthopedic Surgery. Too frequently do we see these cases which have been cast aside by relatives as permanent cripples, when after a course of treatment, wonderful improvement, and in many cases, almost a perfect cure is effected.

The least suspicion of deformity which might be observed by the parents and mentioned to the family physician must not be lightly or flippantly passed with the remark that "They will grow out of it." The rule is that they grow into a worse deformity and the family doctor who disregards the solicitude of parents is responsible for the outcome. It is not a difficult matter for the Orthopedic Surgeon to prevent deformity in bone and joint diseases, but it is a most difficult matter to correct it after cases have been under improper, or no treatment until marked distortion exists.

**Plaster-of-Paris** may be considered the Orthopedic Surgeon's principal stock in trade for there is hardly a condition in which it may not at some time be used. Substitutes, as paper, leather, celluloid, aluminum, rawhide, cardboard, felt, wood, and steel braces of all characters, have all been used, and are being used and have their scope of usefulness, but no one material

serves so many purposes to the Orthopedic Surgeon as Plaster-of-Paris. Several things may be said about its preparation and application. If it is desired to make bandages as they are used, it should be purchased in tin cases in sizes from 10 to 50 pounds, and the best modeling plaster should be used. It must be kept in the can sealed, and when once opened it should be re-sealed by some plaster cream or Mead's adhesive plaster. It is difficult, however, to always have good bandages, for there must be an uncertainty about them. They may set too quick and be brittle, or not quick enough, or not at all and subject the patient to needless torture. For plaster jackets, where elasticity and durability are demanded, the plaster should be so handled as to set slowly; *i. e.*, in less than ten minutes. Where firmness is required without elasticity, the quicker setting takes place the better.

Plaster-of-Paris was first used as a material for the treatment for fracture, in 1851, in St. Vincent's Hospital, New York, by the late Dr. James L. Little and Mathieson of Holland recommended gypsum as a material for the treatment of fracture soon after this date.

When the surgeon makes his own bandages, crinolin of the variety used by milliners for lining hats, or the cheaper grade is best. The water should be hot if it is desired that the plaster set quick, and cold when the opposite is wanted, and salt will hasten the process. When everything is ready, one bandage should be immersed in the water, and allowed to remain until all bubbles cease to arise, when it is ready for use. It is taken out of the water and another is put in, and it will be ready for use by the

time the first is applied. They should be applied from below upward and made to overlap about one-half, taking care to travel up and down with system so that the finished work will be of uniform thickness. The padding for plaster-of-Paris splints for club-foot, knee, hip, wrist, or elbow cases, whether to immobolize for tubercular disease, recent injuries, or following *brisement force*, should be the best quality of ordinary cotton. Absorbent cotton should *never* be used under plaster-of-Paris as it absorbs the moisture from the bandage which destroys the elasticity, so that it no longer serves the purpose for which it was intended. Common cotton does not absorb moisture but will remain dry and elastic for months if necessary. For jackets, stockinette, or neatly fitting cotton undershirts, are best. The bony prominences as the crest of ilium, vertebral spines, over sternum and ribs below the nipples, should be padded with cotton or, better, piano makers felt. In girls where the mammary glands are developed, a piece of cotton should be placed over them to prevent undue pressure. (For further details regarding plaster jackets see article on Pott's disease.) For the removal of these dressings many machines, scissors and knives have been invented. The most universally used instrument is a penknife with a sharp point, *i. e.*, the cutting edge is straight to the point. By wetting the bandage with a sponge along where it is to be cut it becomes soft and is quite easily severed.

The Orthopedic knife devised by the author contains (1), screw driver; (2), nail tool; (3), reamer; (4), button hook; (5), two plaster blades; (6), cork screw.

Next to plaster-of-Paris there is nothing so frequently

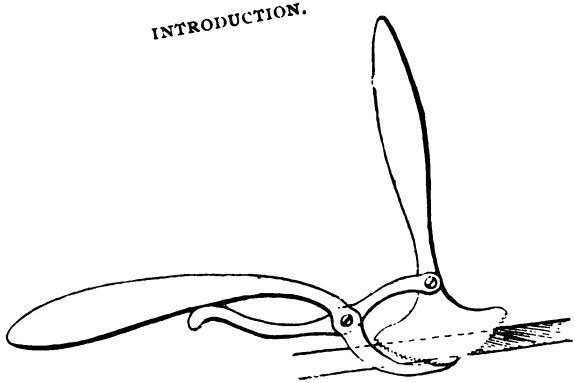


FIG. B.—THE AUTHOR'S SAW.

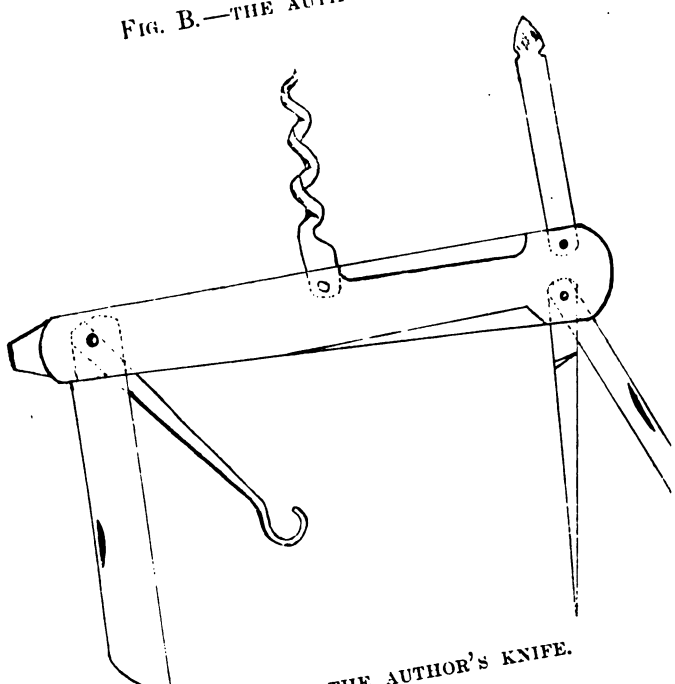


FIG. C.—THE AUTHOR'S KNIFE.

used as *adhesive plaster*. Cheselden, in his Anatomy published in 1740, speaks of its use and the late Dr. S. D. Gross, advocated its use in 1850, and Dr. J. N. Quinbey, wrote a paper on this subject in 1867. (Judson). From that time to the present date it is increasing in favor. To-day it is used for the treatment of flat-foot, club-foot and torticollis, and as a means of applying traction in the treatment of all the tubercular diseases of the extremities, and in fractures, not only of the extremities, but of the clavical, ribs, etc. It is used to secure the initial as well as the distal ends of roller bandages. The variety of plaster most frequently used is Mead's surgeons adhesive, but for traction in hip cases, or where the application is to be continued for several months, the mole-skin plaster serves a better purpose since it is less irritating to the skin.

The abbreviations used by the author in keeping records of cases in orthopedic practice are as follows :

LANDMARKS:

(S.,) Anterior superior spine of the ilium; (S. to S.) Right to left spine of ilium; (U.,) Umbillicus; (V.P.,) Vertebra Preminens; (O. P.,) Occipital protuberance; (Cx.,) Coccyx; (Pub.,) Pubis. (S. C.,) Semilunar cartilage; (Pnm.,) Perineum; (M.,) Maleolus; (Sty.,) Styloid process, wrist; (Olec.,) Olecranan; (Acr.,) Acromion process; (I. A. S.,) Inferior angle of scapula; (S. S. N., Supra-sternal notch;(X.,) Xiphoid cartilage; (Troc.,) Trochanter; (Cond. F.,) Condyle of femur; (Cond. H.,) Condyle of Humerus; (Ax.,) Axilla. R. and L. should be profixed to indicate the side.

CIRCUMFERENCES.

| | | | | | |
|---|---|---|---|---|---|
| T. | Thigh. | H. | Heel. | N. | Neck. |
| K. | Knee. | A. | Arm. | Th. | Thorax. |
| C. | Calf. | F. | Forearm. | Ab. | Abdomen. |
| I. | Instep. | P. | Palm. | Pv. | Pelvis. |

CLASSIFICATION.

1. Congenital and Acquired Deformities of the Feet.
   (*a*) Club Foot.
   (*b*) Flat Foot.
   (*c*) Bunion, Hammer Toe and Ingrown Toe Nail.
2. Congenital and Acquired Deformities of the Hand.
   (*a*) Club Hand.
   (*b*) Supernumerary Digits.
   (*c*) Webbed Fingers.
   (*d*) Dupuytren's Contraction.
   (*e*) Snap Finger, and other deformities.
3. Tubercular Diseases of Bones and Joints.
   (*a*) General Consideration.
   (*b*) Knee Joint Disease.
   (*c*) Ankle Joint and Tarsal Disease.
   (*d*) Shoulder Joint Disease.
   (*e*) Elbow Joint Disease.
   (*f*) Wrist Joint and Carpal Disease.
   (*g*) Sacro-Iliac Disease.
   (*h*) Hip Joint Disease.
   (*i*) Pott's Disease.
4. Internal Derangements and Diseases of Joints.
   (*a*) Synovitis.
   (*b*) Chondritis.
   (*c*) Diseases and Injuries of Cartilage and Ligaments.

(*d*) Loose Bodies.
(*e*) Ankylosis.
(*f*) Subluxation.
(*g*) Diseases of Tendons and Bursae.

5. Deformities Resulting from Lesions of the Nervous System.
(*a*) Lateral Curvature.
(*b*) Torticollis.
(*c*) Infantile Spinal Paralysis.
(*d*) Infantile Cerebral Palsy.
(*e*) Charcot's Disease.
(*f*) Anterior Metatarsalgia.
(*g*) Hysterical Deformities.

6. Diseases of Nutrition and Blood Changes.
(*a*) Rickets, and Coxa Vera.
(*b*) Infantile Scorbutus.
(*c*) Arthritis Deformans.
(*d*) Osteo-Arthropathies.
(*e*) Syphilitic Joint Lesions.

7. Traumatic Deformities.
(*a*) Sprains.
(*b*) Chronic Dislocation.
(*c*) Ununited Fracture.
(*d*) Deformity Following Fracture.
(*e*) Tenoplastic Surgery.
(*f*) Plastic Surgery.

8. Congenital Deformities.
(*a*) Dislocation of Hip.
(*b*) Deformities of the Thorax.
(*c*) Absence of Patella.
(*d*) Other Congenital Defects.

# CONGENITAL AND ACQUIRED DEFORMITIES OF THE FEET.

## CLUB FOOT.

**Club foot,** more correctly called talipes, is a distortion of the foot in any direction from the normal position, or interference with the normal range of flexion, extension and rotation.

**Varieties.** There are four primary or simple varieties, viz. talipes-equinus, talipes-calcaneus, talipes-varus, and talipes-valgus. There may be a combination of any two of these varieties, talipes equino-varus, or talipes equino-valgus ; talipes calcaneo-varus, or talipes calcaneo-valgus. These deformities are exaggerated as the influences which produce them predominate. Other acquired forms are found in addition to the foregoing varieties. These are the *pes cavus*, when the arch of the foot is very high with the sole hollow ; *pes planus*, when the arch is flat and flat sole.

**The anatomy** of the foot must be known before club foot can be properly understood, or treated. The bones of the foot which have to do with club foot are the seven tarsal, the five metatarsal, and the tibia and fibula. The joints of the foot which may become partially or completely dislocated are the tibio-tarsal, or ankle, medio-tarsal, or Chopart's, and calcaneo-astragaloid. The muscles which cross the ankle joint and produce club foot are twelve in number, and are divided into four groups, viz: first, or superficial calf group,

made of soleus, gastrocnemius and plantaris, which extend the foot; second, or deep calf group, composed of the tibialis posticus, flexor longus digitorum, and flexor longus hallucis, which adduct the foot; third, or anterior group, composed of extensor longus digitorum, extensor proprius pollicis and tibialis anticus, which flex the foot; and fourth, the fibular group, composed of the peroneus longus, brevis and tertius, which abduct the foot. These groups of muscles have power to move the foot in the four primary directions, viz: flexion, extension, abduction and adduction, and they also act in concert, producing the various complex and graceful attitudes of the foot. While one group only may be paralyzed, producing a simple variety, two groups are most frequently involved, producing a compound variety of club foot. The weight of the body is received at three points, viz: posteriorly by the tuberosity of the os calcis, and anteriorly by the distal end of the metatarsal bone of the great toe, and of the fourth and fifth metatarsal bones. This makes a tripod of supporting points, and from one point to the other we find the bones describing arches. These arches are the antero-posterior and the transverse. The antero-posterior, or the long arch, varies but slightly in races and individuals. The normal foot with normal arches is placed at right angle to the tibia, and a line drawn down along the crest and dorsum of the foot passes longitudinally through the second toe. Deviation of the foot inside of this line may be considered a variety of varus, and valgus when it is external to it.

**The causes** of club foot are congenital and acquired. Of the congenital causes, maternal impressions have been

considered a factor by some authorities. Heredity plays an important part. The rate is increased from 1 in 2,000 in non-consanguineous to 1 in 165 in consanguineous marriages. Mr. Adams, of London, reports a club foot family, and the writer has seen two families where this tendency was shown. Mechanical pressure *in utero*, from deficient liquor amnii, pressure of the cord, etc., are influences which no doubt assist in the production of club foot. Arrest of development, retarded rotation of the foot, and inter-uterine traumatisms must all be considered as factors.

**Symptoms** of club foot are usually so prominent and well-known that repetition is hardly necessary. The physician who has a knowledge of the normal foot will have no difficulty in determining the existence of an abnormal condition. It must be remembered that in the congenital variety no pain, swelling, or inflammation exists, except such as results from pressure and from the false position of the foot. Feet may be temporarily distorted by acute inflammatory diseases, as osteomyelitis, tuberculosis or synovitis, and in all of these conditions the history must be considered.

The position of the foot in the simple varieties is as follows: (Fig. 1.)

**Equinus** (*a*), heel elevated, foot extended and patient walks on ball of toes.

**Calcaneus** (*b*), toes raised, foot flexed and walks on heel.

**Varus** (*c*), inside of sole raised and turned inward, anterior portion adducted and walks on outside of foot.

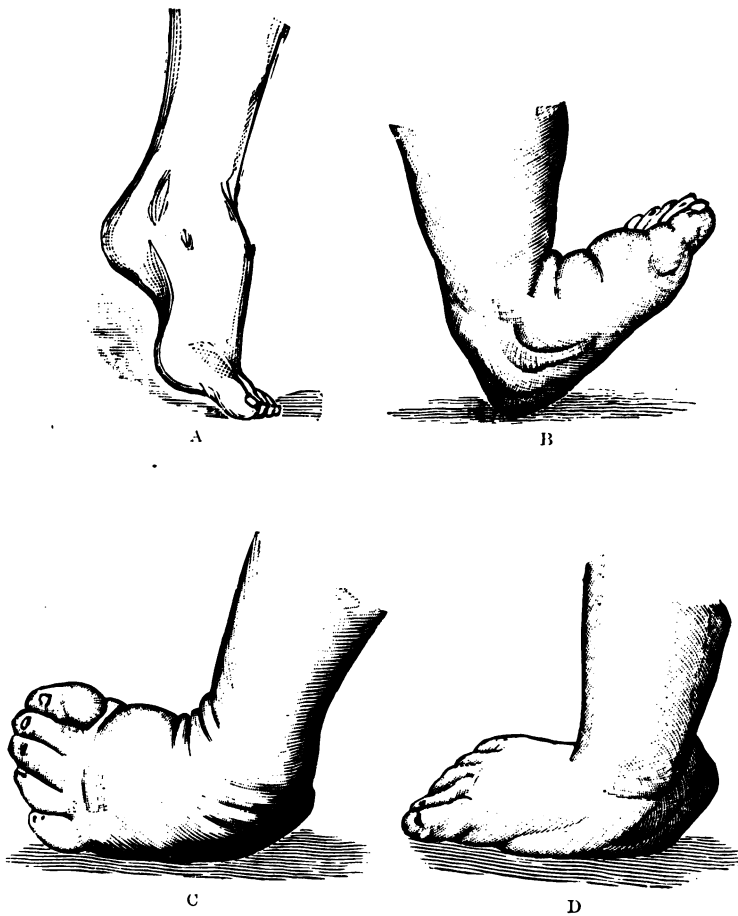
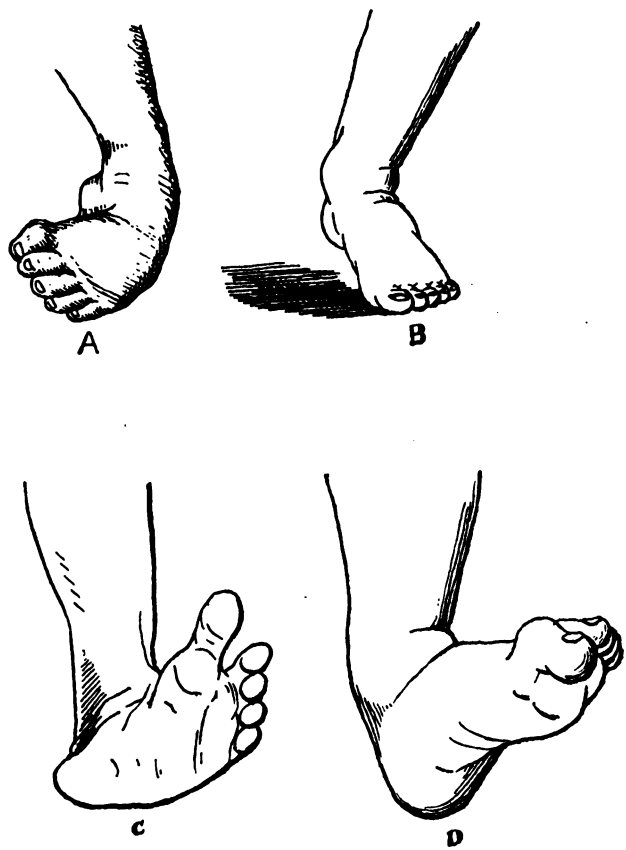



FIG. 1.

VARIETIES OF SIMPLE CLUB FOOT.

**Valgus** (*d*), outside of sole raised and foot turned outward, particularly anterior portion.

The following positions of the foot may be considered to define the compound varieties : (Fig. 2.)




VARIETIES OF COMPOUND CLUB FOOT.

FIG. 2.

**Equino-varus** (*a*), heel elevated, foot extended and inverted, sole turned inward and backward, and patient walks on the outside of foot.

**Equino-valgus** (*b*), heel elevated and turned outward, outside of sole everted and extended, walks on inside of sole and ball of foot.

**Calcaneo-varus** (*c*), toes and inside of sole raised, foot flexed, sole turned inward, anterior portion adducted, and walks on outside of heel.

**Calcaneo-valgus** (*d*), toes and outside of sole raised and everted, foot flexed and walks on inside of heel.

A special consideration of the several bones of the foot in every variety of the deformity would be too extensive a subject to be permitted here. It must be remembered that after a bone has been in dislocation for any length of time the old articular surfaces have been effaced and in some cases new ones created, but even if new articular surfaces are not formed, new relationships and pressure points for the bones must exist. These new relationships eventually become fixed and the normal surfaces are practically obliterated from non use.

In congenital equino-varus, the astragalus is dislocated forward, the cuboid is dislocated inward from its articulation with the os calcis, the navicular is also thrown inward and upward from its articulation with the head of the astragalus, and the other articulations are more or less disarranged. In valgus, the bones of the foot are thrown outward and upward and the transverse arch is destroyed. In equinus, the extended position of the foot dislocates the medio-tarsal joint for-

ward and downward, and in calcaneus the same joint may be dislocated upward and backward. As a result of these various dislocations continued for, it may be, years, it may readily be seen that the bones assume an entirely new relationship to each other, and that in an effort at correction these abnormal relationships must be restored to the normal, which necessarily requires considerable time.

Townsend, in a statistical paper on club foot, concludes as follows :—

"Equino-varus is the most frequent deformity, constituting about three-quarters of all the cases.

Both feet are more often affected than one.

Right foot more often than the left.

Non-congenital club foot most frequently due to paralysis.

The paralytic form usually due to poliomyelitis.

Flat foot more commonly affects both feet.

Males and females about equally affected in non-congenital club foot.

Equino-varus, equinus and calcaneus most common forms of paralytic club foot.

When both feet are affected, the deformity is usually the same in both.

Equinus and calcaneus are rare as congenital deformities, but common as paralytic."

**Pathology.** Parker and Shattuck, of London, and Scudder, of Boston, have demonstrated by examination of pathological specimens that the chief lesion in talipes equino-varus is an exaggerated obliquity of the neck of the astragalus upon the body of the bone, and Kermissen and Carpentier, of Paris, confirm these

claims. The normal angle of the neck to the body, ranges from 10 to 35 degrees, and Parker found the angle in equino-varus to be about 40 to 63 degrees, and Scudder 50 degrees. In equino-valgus the same angle was found to be from 140 to 150 degrees by Kermissen and Carpentier.

Sayre quotes Lapeyre as saying that the primary condition in equino-varus is incomplete progressive dislocation of the various joints of the foot, the bony deformity being entirely secondary to the arrested development or increased growth of the parts, brought about by the crowding together of the bones on the plantar and internal surface and their separation on the dorsal and external surface. From an anatomical standpoint two new facts are brought out by the author (Lapeyre): (1) The hypertrophy of the dorsal ligaments, especially the external dorsal, and atrophy of the plantar ligaments. (2) The weakness of the scaphoid insertion of the muscles of the leg.

Hartley divides the degree of deformity in club foot into three classes; "First—When the foot can be readily placed in the normal position and in which the angle between the foot and the leg is greater than ninety degrees. Second—In which the foot can be reduced less readily, and in which the turning of the foot inward is greater, the deformity being due to the contraction of tendons and fascia. Third—In which there is no possibility of manual correction, and in which all the tissues upon the mesial side are shortened." Hartley considers in detail the normal shape of the tarsal bones in connection with the abnormal shapes and relationships found in the different varieties of club foot. He

operated upon fifteen cases of equino-varus by removal of more or less bone structure in twenty-six feet, and had nine perfect results, fourteen good results, one satisfactory and two imperfect. He also says there is no question but that the best results are obtained by mechanical treatment in congenital club foot, during the first thirty months of life, during which time the growth of the foot is relatively greater.

**Treatment.** All Orthopedic Surgeons agree that the earlier treatment is begun in club foot, the better will be the result. Dr. De Forest Williard concludes a paper upon the early management of club foot in the following style:

"First—The first month of life is the period of the greatest growth, and to neglect treatment of club foot during this time is to permit the bony and soft tissues to become permanently misshapen.

Second—Rectification should be commenced from birth by various simple methods.

Third—Correction can be accomplished by a variety of dressings.

Fourth—Manipulation is exceedingly important for the production of a flexible foot.

Fifth—Apparatus should be applied as soon as the foot and leg are in position for its application.

Sixth—Rectification and manipulation should be continued up to the age when the infant is ready to walk, at which time, if the foot cannot be placed on the sole firmly, operative measures should be instituted."

The treatment of club foot depends upon, first, variety of deformity; second, age at which treatment is instituted and the duration of the displacement, and, in

the language of Mr. Adams, "a judicious combination of operative, mechanical and physiological means." By *physiological* and mechanical means is meant manipulations, massage, electricity, and retaining splints and braces of all varieties, including daily stretching. *Manipulations* have been practiced from Hippocrates to now, with and without anesthetics, with and without force with the hands, and with stretching machines, and we will continue this treatment ourselves, as well as see others use it. To say the most for it, however, it is working in the dark and no definite promises can be made. *Massage* and *electricity* develop muscles here as in other parts of the body, but to depend upon these measures to cure or even assist, in very severe or even moderate cases, is to consider time of no value

**Correction**. Braces have been used for centuries and cases are going on uncorrected. There are, no doubt, as many club-foot braces and shoes as orthopedic surgeons. This means that the surgeon does not find the braces in existence satisfactory, and he tries to improve, with as much success as his predecessors. In Tamplin's modified, Little's modified Scarpas, we have the earliest and best idea. Stromayer, Adams, Langge, Judson, Shaffer (B.), and Bradford are the names of some of these inventors and all their braces have merit. Elastic traction braces were later introduced by Davis, Sayre, Barwell, Williard (C.), Beely, Bradford, Taylor (D.), and Lovett.

After correction has been made with plaster-of-Paris, and the foot readily stands in a normal position, the brace used by the writer to hold the foot in this position is shown in Fig. 4. It is not very different from

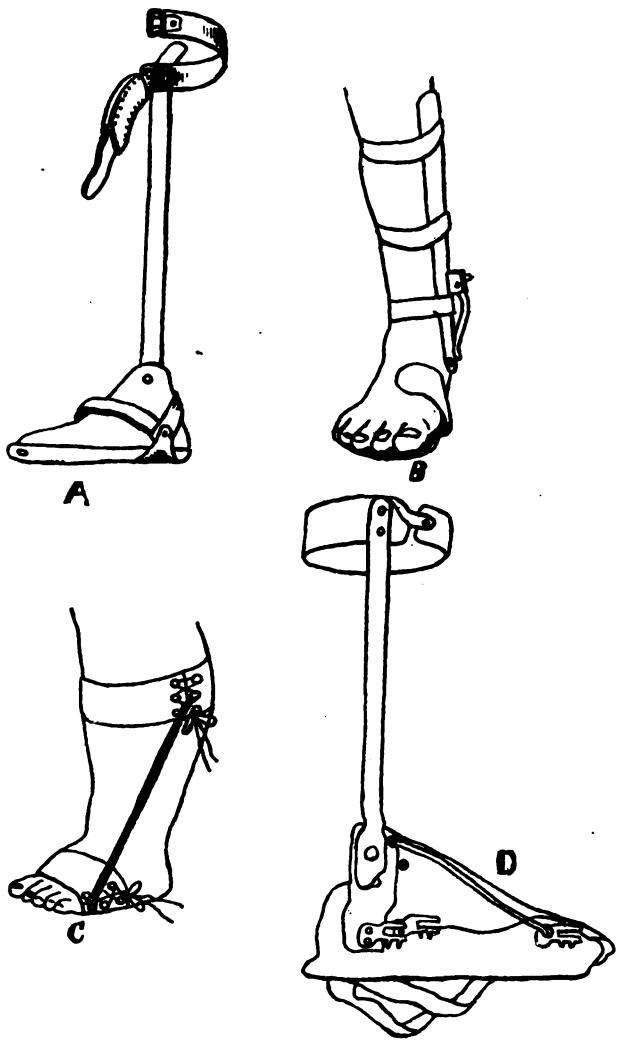



FIG. 3.

the Judson (Fig. 3-a) except it is made to fit the foot as is a flat foot brace.

It has an extension from the sole plate over the distal end of the tarsal bone of the great toe, and there are two straps across the top of the foot; and there is a stop joint, which prevents extension of the foot beyond a right angle. The posterior strap is just high enough above the foot plate to permit the os calcis to pass under it. The object of the two straps across the top, is

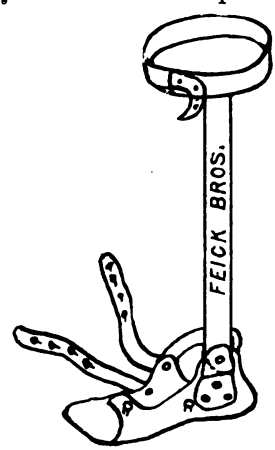



FIG. 4.

that pressure may be made at necessary points. The position of the posterior strap rests against the head of the astragalus, pressing downward and backward, and beginning, as it does, at the apex of the external part of the foot-plate, constriction is not likely to occur.

The anterior strap starts from the outside of the foot plate and passes across, and is secured to the projection from the inside of the plate over the metatarso-phal-

angeal joint of the great toe. The principle pressure made by this strap is over the metatarso-tarsal joints forcing the foot downward against the foot plate.

It must be thoroughly understood, that braces are not correctors of club foot, but are to be used as retainers during final convalescence.

**Relapse** after club-foot operations is due to the carelessness of the attendants, for all cases, when seen early, can be absolutely corrected, and in neglected cases at all ages, such a degree of correction can be attained as to make the foot practically normal, so far as use and appearance is concerned.

**Operations** for club foot include tenotomy, myotomy, syndesmotomy, tarsotomy, tarsectomy, multiple tenotomy, open operation of Phelps, *brisment-force* and amputation.

**Tenotomy**, the accepted method of operation in all mild cases, is best done with a tenotome 3-16 in. wide and ¼ in. long. Fig. 5. The puncture is made

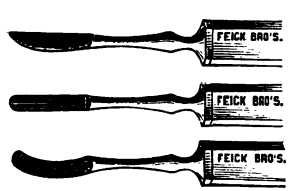



FIG. 5.

through the skin to one side of the tendon or fascia to be severed, and the knife is then pushed underneath the tendon on the flat. When it is in the desired position the edge is turned toward the skin and section of the contracted structure made by a sawing motion of

the knife. As the tendon is severed it snaps and the ends recede. Little hemorrhage follows such operations unless the operator forgets his anatomy and severs a blood vessel. The operation is done under an anesthetic and under antiseptics. *Dressings* consist in iodoform gauze, a small piece over the puncture covered by a larger piece of absorbent cotton. In all cases where an anesthetic is used, *brisment-force*, with the hands in children, or by a wrench in adults, is necessary to correct the deformity. In the treatment of various forms of talipes, after tenotomy of the tendo-Achillis, or the plantar fascia, or of muscles and ligaments, or after such other operations as the individual case may require, great force is frequently necessary to break up the adhesions and rupture of the abnormally short tendons which may be found between the bones. These abnormal relationships must be disturbed. The hands of the surgeon are not always sufficiently powerful to even fracture the bones to overcome the deformity, The "T. T.," or "Thomas Twister," is not entirely satisfactory as a club-foot wrench. Phelp's appliance is all-powerful, but is quite complicated, expensive and cumbersome, and neither of these appliances can be kept absolutely clean. The wrench herewith illustrated (Fig. 6) is simple, can be kept aseptic, and is not extensive. While the handle is to one side of the foot in the "T. T.," the handle is in the centre of this twister, and there is great advantage given the operator in power while there is less danger of the wrench slipping around the foot. The set-screws allow an adjustment to any sized foot. The bars as they come in contact with the skin are protected with

rubber tubing. When it is desirable to forcibly correct the tibio-tarsal joint, the foot is passed entirely through the aperture in the wrench, or the wrench may be taken apart and adjusted around the ankle. The distal bar rests above the malleolus on one side, and the proximal bar against the tarsal bones below the malleolus on the

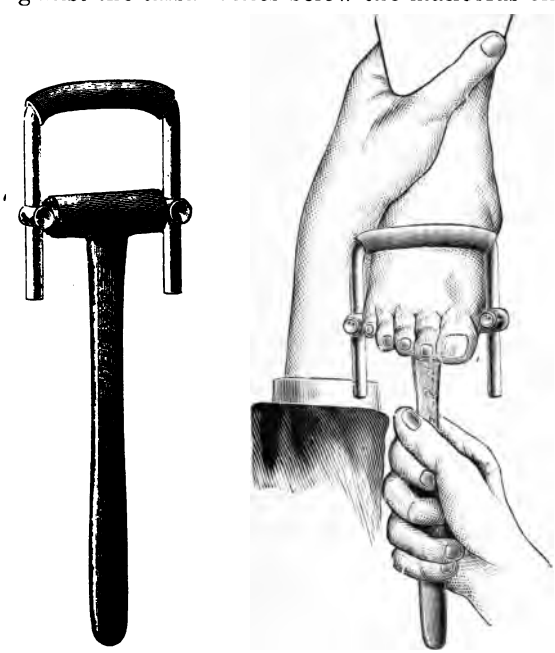


FIG. 6.

THE AUTHORS CLUB FOOT WRENCH.

opposite side. Daily stretching of the contracted tissues by a screw correcting machine is practiced by Shaffer with gratifying results.

In his most admirable article on club foot, in which many cases are reported, Hartley divides the operations

necessary into two classes: "First, upon soft parts; second, upon bone. The bone operations necessary in these cases are: First—Extirpation of the astragalus, partial or complete, with or without the external malleolus. Second — Cuneiform osteotomies, including parts of the astragalus, os calcis, cuboid, scaphoid and cuneiform bones, with or without tenotomy and fasciotomy. Third—Extirpation of the astragalus and cuneiform osteotomy."

The best method of holding the foot in a corrected position is with a plaster-of-Paris dressing. Braces in my hands are of no value, either as a corrective or retentive dressing, until after the foot is corrected, while plaster-of-Paris has served well, and in fact is the only dressing in which is reliable. It grasps the foot as desired and makes pressure at selected points and at proper angles, accomplishing more than with the hands. Braces are ill-fitting, making pressure generally upon undesirable points, and when not in perfect position tend to increase, rather than decrease, the deformity.

After operating, the second dressing of club-foot is made in from ten days to three weeks.

**Complications** are rare, hemorrhage seldom follows, and suppuration is almost never seen. Nerve injuries do not often occur, and non-union of a tendon, has never, in the writers hands been a sequel. Sloughing either of the inside of the foot from tension, or over the astragalus on the outside of the foot from folding in of the redundant skin and pressure, occasionally occurs, but is not a serious complication.

For the treatment of talipes equino-varus in patients over twelve years of age, in which the deformity is se-

vere and other methods have been tried and failed, the one operation above all others is that of Phelps, of New York.

Dr. Phelps says, regarding the club-foot operation which bears his name: "The method which I propose to govern the management of club-foot, requiring operative work, is this:—

1. Exclude all cases which, by manipulation or force, can immediately, or in a reasonable length of time, be cured; then the following rule should be followed:

2. Cut the contracted parts as they first offer resistance, cutting in the order of those parts which first contracted when the deformity was produced. The operator will then proceed, after strong manipulation or force is applied with a club-foot machine or with the hands, to subcutaneously divide, first the tendo-Achillis. If the skin is not short, subcutaneous tenotomy in the sole of the foot can be made, beginning directly in front of the inner malleolus and carried down to the inner side of the astragalus. Through this incision, in the order given: (*a*) Tenotomy of tibialis posticus; (*b*) division of adductor pollicis; (*c*) division of plantar fascia through the wound; (*d*) division of flexor brevis; (*e*) division of long flexors; (*f*) division of deltoid ligament, all its branches.

3. Linear osteotomy through the neck of the astragalus.

4. Resection of a wedge-shaped piece of bone from the body of the os calcis, the point meeting the linear osteotomy through the neck of astragalus. The foot will now swing to a straight position."

"To summarize: In 93 cases there were 151 operations performed, the average age being six and one-half years, the average time of healing of the primary wound was four weeks; there were 117 cases of blood-clot organization, four catgut, and 19 failures in 140 cases. The duration of after treatment was ten months. On the fourth month after operating the feet were all straight. Out of the 140 cases traced, after one year 10 cases were found relapsed, or partially so, from neglect. Relapses, when they occur, take place during the first year after the operation as a general rule."

This is a real surgical advance of merit. By this operation we can dispose of all these obstinate and persistent cases of chronic deformity of the foot, which either increase the number of cases in free dispensaries, or the riches of the orthopedic surgeon, and which go the rounds from one clinic to another, from one orthopede to another, with slight improvement under all, it may be, only to again relapse under no treatment. Cuneiform osteotomies, tarsotomies, tarsectomies of the astragalus and other bones, evacuation of bones, resection, excision and a combination of these various operations, have been practiced. They have their use in selected cases and are all resorted to. Osteotomy of the tibia and fibula above the malleoli has been done. Of the many methods of treatment which have been recommended and considered, the following would appear to be safe order of procedure:—

1. In children, or in cases in which a correction can be obtained with the hands, plaster-of-Paris, constantly worn, renewing it every week, or as often as necessary, will effect a cure.

2. In all cases where correction cannot be made without chloroform, subcutaneous tenotomies and the severing of all resisting structures, and the use of a wrench to break up adhesions, should be practiced, followed by the use of plaster-of-Paris as above directed.

3. The persistent and neglected cases, in which one or more operations have been done, if the case is one of equino-varus, a Phelps' operation should be done, and especially is this operation demanded if the case is over twelve or fifteen years of age, for no benefit can be expected from braces, and other operations offer a less serviceable foot.

4. In resistent club-foot, where all other methods fail, a bone operation is demanded, the variety of operation being dependent upon the nature of the deformity.

Wilson, of Philadelphia, in a paper on bone operations for the correction of club-foot, may be quoted as follows:

*First.* As to the statement often made that the mortality in bone operations in club-foot is a high one; in an analysis of four hundred and thirty-five cases, three died from septicemia, three diarrhea, and one from carbolic acid poisoning, and in three weeks after amputation, the seventh died from septicemia, making a mortality of 1.6 per cent. Suppuration occurred in 3.45 per cent. of these cases.

*Second.* The age of the patient when such operation was deemed advisable or expedient. In 414 cases the age ranged from three weeks to forty-seven years of age; 53 per cent. under the age of ten; 29 per cent. prior to the age of six years; 7 per cent. prior to the

FIG. 7.

CASE UNDER TREATMENT.

FIG. 8.

SAME AS FIG. 7 WITH PLASTER-OF-PARIS DRESSING.

FIG. 9.

TALIPES EQUINO-VARUS.

FIG. 10.

SHOWING PLASTER-OF-PARIS DRESSING FOR CLUB FOOT.

age of two years; 55 per cent. between the ages of six and eighteen.

*Third.* The form of operation generally selected. In 156 cases, or 36 per cent., the astragalus was the only bone removed. In 274 cases, or 63 per cent., not only was the astragalus removed, but other surrounding bones entirely or in part. In one case an osteoplastic resection was done. Tarsectomy was done in 2.7 per cent., and a wedge of tarsus was removed in 18 per cent. of cases. Phelps' operation, although not strictly a bone operation, was done in 25 cases, or 5.8 per cent., eleven of which were with bone operations and fourteen without. Linear osteotomy of various parts, as devised and performed by Bradford, was done twenty-two times; osteoclasis of tibia and fibula, nine times by Grattan; arthrodesis six times. Reeves' operation six times.

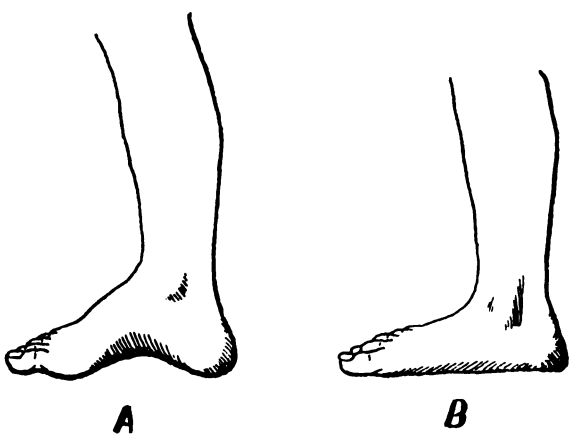
*Fourth.* Whether the general usefulness of the foot was better than could be obtained by other means. Nine cases were not entirely corrected, nine were unsatisfactory. Seventeen showed a tendency to recur, while five required subsequent operations. An operation was done in two cases for pain."

ACQUIRED CLUB-FOOT.

Acquired club-foot includes all those cases following infantile spinal paralysis, infantile cerebral palsy, synovitis of ankle, ostitis of tarsal bones, from cellulitis following typhoid fever and erysipelas, dislocations, Potts' and other fractures, rapid growth, pressure of bed clothing during sickness, cicatrical contractions from burns, and Gibney reports one case due to exostosis of the fibula, following fracture of this bone. When the cause

of this deformity is known, the pathology is understood, and a diagnosis need not be difficult.

**Treatment** is directed to the development of the muscles in paralytic cases, and restoring the parts to a normal position. Course in gymnastics as given for infantile spinal paralysis is to be carried out here. Cases in which adhesions are extensive, or ankylosis is rigid, should be wrenched straight. If tendons are found short they should be cut, and other tissues severed which interfere with correction.




A. Pes cavus. B. Pes planus.

Fig. 11.

**In pes cavus,** (A., Fig. 11) or that variety of club-foot akin to the Chinese woman's foot, there is an abnormally high arch.

Treatment consists in gymnastics to develop the muscles, and in severe cases breaking up of adhesions with a club-foot wrench under an anesthetic, and cutting such tissue as may be found abnormally short.

CASE I. Samuel M., aged 37. Had an attack of anterior poliomyelitis at four years of age, resulting in talipes equinus in both feet, the right foot being worse than the left. (See A and C, Fig. 12.)

Operation consisted of tenotomy of the tendo-Achillis and the plantar fascia of each foot, and forcible breaking up of adhesions about the tarsal bones with a wrench. The feet were put in plaster-of-Paris, and new dressings re-applied once a week for four weeks, when the patient was able to walk home

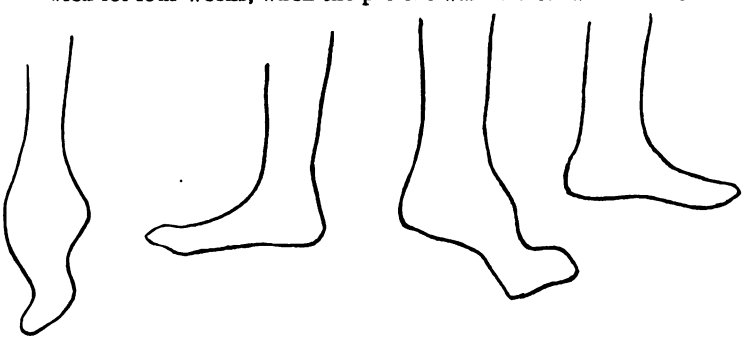



FIG. 12.

on crutches. A shows the right foot before, and B after treatment, and C shows the left foot before, and D after treatment. The patient always used crutches before treatment, but did not need them afterward. Recovery practically perfect.

## FLAT FOOT.

Flat foot is a mild, very common, and much neglected form of talipes valgus, which has been considered under the various heads of flat foot, broken-down feet, weak foot, etc., is akin to *pes planus*.

The points of support in a normal foot are the tubercle of the os calsis posteriorly, and the distal ends of

the first and fifth metatarsal bones. The transverse arch is formed by the arching of the foot from the first to the fifth metatarsal bones in front. The apices of these arches are formed by the bases of the metatarsal,

FIG. 13.

the cuboid and the cuneiform bones. The arches should be so high in the normal adult foot that the plantar surface does not touch from the heel to the metatarso-phalangeal articulation, except along its outside.

To study the foot from a gross inspection, a line

drawn down along the crest of the tibia should pass through the centre of the second toe. Any deviation from this line must be considered abnormal. In a case of talipes equino-varus, this line may pass entirely outside of the foot, or in talipes valgus the line may barely touch the foot anterior to the internal malleolus. In the condition under consideration, as it may be observed in Fig. 13 B, the line referred to passes down through the inside of the foot, passing off at the articulation between the scaphoid and internal cuneiform bones. In order that the foot may support the body perfectly, the weight must fall over the centre of the arches. If, for any reason, the weight is upon the outside, the tendency is to increase the deformity, and place it in such a condition as to make it more difficult to bear the superincumbent weight.

Flat foot is a giving away of the arches of the foot, and a resultant shifting of the weight to be carried from directly over the arches to any point internal to this.

The conditions within the foot are paralysis of muscles whose tendons have to do with the support of the foot, and letting loose of the plantar fascia, painful affections of the foot which may necessitate the shifting of the weight to one side, etc.

Of the primary varieties of club-foot, the one which is most nearly akin to that of the flat foot is valgus, and by some it is considered under the same head. Whitman, who is an authority upon this subject, considered it under the head of "Weak Foot." Dr. Lovett, of Boston, who examines the feet of every nurse before she is permitted to enter any of the training schools of that city, prefers to consider it a deformity due to the lack of support and calls it "Broken-Down Foot."

It is not essential, however, that great deformity be found in order that the condition of the flat foot be present. Whitman says that great pain may be present as a result of weak foot without the foot being flat. In all painful feet, however, this deformity is generally found, as well as the eversion as determined by the usual deviation from the tibio-dorsal line.

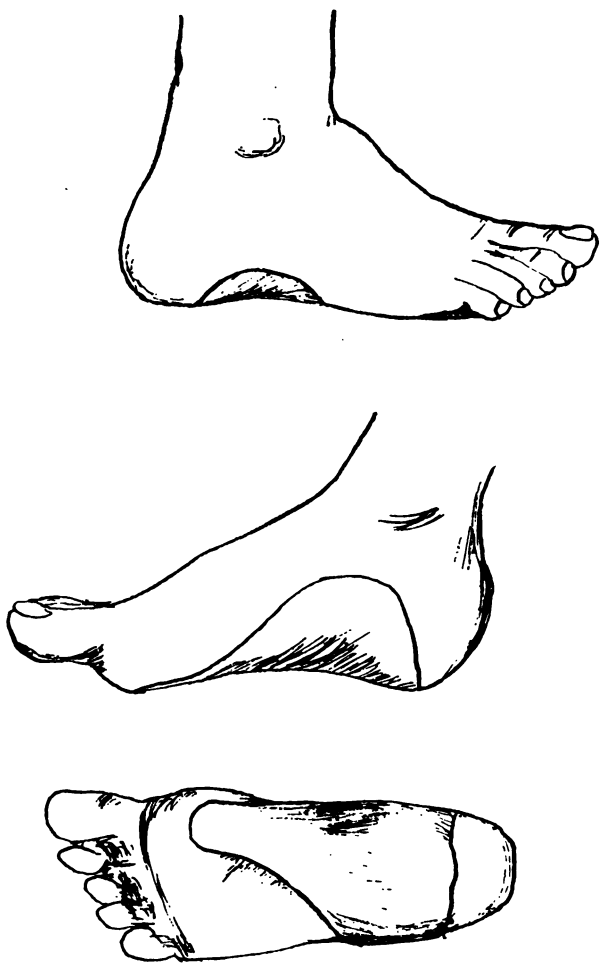
It is probably preferable for convenience to subdivide this deformity in order that a more systematic study may be made.

This subdivision may be made as follows:

1. Weak foot without deformity.
2. Weak foot with a minimum of deformity.
3. Broken-down foot with eversion, but without ankylosis or pronation.
4. Exaggerated and persistent flat foot with or without ankylosis.

It must be remembered that *all* flat feet are not to be considered pathological, and great deformity may exist. It is claimed by some writers that all babies are flat footed, but Dr. Lovett has demonstrated that the apparent condition of flat foot is due to a deposit of fat under the normal arch, which serves as a support and prevents it from breaking down, and which is absorbed at the age of four or five years.

A study of the arch of the foot is best made by taking imprints of the feet on paper. The plantar line of the super-corrected foot will be found to be deflected under the centre of the arch. The apex of the angle formed by this deflection points outward. In an exaggerated flat foot the apex of the angle formed by the above-described lines point inward. If Meyers' line is



FLAT FOOT BRACE. AFTER WHITMAN.

FIG. 14.

united with the tibial line the same condition will be found.

**The symptoms** to be found in flat foot are weakness and discomfort, or pain of varying severity; and, in marked cases, severe pain after being on the feet all day, this pain disappearing after a period of rest. The pain may extend up the leg. In old cases the foot is greatly swollen, the toes edematous, the foot is hot and flushed and may prickle, the veins are dilated, the feet may perspire, and sensitive points are generally found.

The foregoing symptoms may have as associates backache, aching of the limbs, edema extending to the legs, metatarsalgia, and inflammation of the tarsal and phalangeal joints.

**The causes**, as enumerated by Lovett, are: 1. Badly-fitting shoes. 2. Weakness or inefficiency of muscles. 3. Excessive weight. 4. Short gastrocnemius. 5. Rickets. 6. Infantile spinal paralysis. 7. Direct traumatism. 8. Locomotor ataxia.

Space will not permit a consideration of these causes in detail. It must be said, however, that ill-fitting shoes cause flat foot.

If tracings of babies' feet are made, the inside of the foot will be found straight. A tracing of the foot of any man or woman who wears the shoes of the day, regardless of shape, will show that Meyers' line will pass entirely inside of the heel.

**Treatment.** — Treatment is subdivided into: 1. Massage. 2. Gymnastics. 3. Manual correction. 4. Mechanical. 5. Operative.

Massage is of importance, and should be carried out in cases of edema of the toes and foot.

Gymnastics should be practiced to develop the muscles that are weak, and to otherwise strengthen the foot. The one exercise of most value is to rise on tip-toe, throw the heels out, and allow the heel to drop, repeating this twice each day, up to fatigue. This, as will be seen, calls into use the calf muscles (a weakness of which, according to Shaffer, is a cause), as well as other muscles which act as supports to the foot.

Manual correction consists in the inversion of the foot with the hands. The patient can do this by crossing the left leg over the right knee, grasping the left ankle with the left hand, and with the right hand grasping the same foot, palm in contact with the sole, and forcibly draw the toes toward him. This should be repeated as frequently as convenient and carried to tolerance.

Mechanical treatment in the majority of cases is sufficient to correct the deformity, but occasionally a super-correction cannot be obtained without the use of an anesthetic. In some cases deformity with ankylosis exists, and there is a marked dislocation of the astragalus, as is shown in the photograph. (Fig. 13.) A corresponding marked depression is found below the external malleolus. In such cases an anesthetic should be administered, and the deformity corrected. This correction, in some cases, requires great force. In a recent operation a brother of the patient was assisting with his muscle, when there was a distinct snap in the joint, and the brother looked significantly. He was assured, however, that we had not produced a fracture, but a reduction of a dislocation. The only instrument which serves the operator well is the club-foot wrench, shown in Fig. 6.

To refer to mechanical treatment, or the method of making a mechanical support, the procedure is described as follows:

1. Super-correct the foot, under an anesthetic and with a wrench if necessary.
2. Put it up in plaster-of-Paris bandage from the toes to above the ankle.
3. After removal fill with plaster-of-Paris.
4. Have an iron casting made from this by a foundryman.
5. Make over this a perfectly-fitting steel insole, which should terminate anterior to the tubercle of the os calcis and posterior to the distal ends of the metatarsal bones, and should include the scaphoid, internally, and the base of the fifth metatarsal bone, externally.

The steel insole should be plated or tinned, as these metals are more durable than nickel, and are not so readily corroded by perspiration. This is worn outside of the hose, and in its use a larger shoe is not necessary than the one worn before the correction of the deformity. It rests directly upon the sole of the shoe without anything to anchor it. If it is made correctly it fits the foot perfectly in the proper position, and it will keep that position in about the same manner as one's hat keeps its position. It cannot turn around, although it is not attached to the head. Dr. Ansel G. Cook attaches it to the shoe. Dr. Lovett attaches it to the inner sole of the shoe.

## INGROWN TOE-NAIL, BUNION AND HAMMER TOE.

**Ingrown toe-nail,** a most common affliction, like many other conditions, is the result, in the majority of cases, of the folly of fashion. Savage races and classes of humanity who habitually go barefooted never have this trouble, and those races of people who do not wear tight shoes are exempt as well. Such a thing as an ingrown finger-nail has not come under my observation. Ingrown nails must be taken as evidence that the foot has worn an ill-fitting shoe. This does not mean that a shoe has been too tight or too loose, but that the fit has been improper. There are two essentials in the selection of shoes in order that deformity may not result, viz: First, a neat-fitting instep, and second, roomy toes. Under the first heading it must be understood that unless a shoe fits neatly across the vamp the toes cannot have room. From the fact that almost all shoes are made so that the heels are higher than the toes, the natural tendency of the foot is to slide forward. This condition will always occur, and the higher the heel the greater the tendency, unless there be a force to resist it. As the foot slides forward—and as a matter of observation this is the cause in all cases of deformed toes—the toes are hugged together and resemble very much the fingers when squeezed tightly. For the past few years the conventional pointed-toed shoe has been worn by almost everyone who would be in style. These pointed-toed shoes, as may be seen, further tend to crumple up the toes, and to allow them to override each other or double under. Toes in which

the flesh overrides the nail the least, only encourage the tendency, and when the distal corner of the nail begins to imbed itself into the soft parts it acts as an irritant. This encourages the deformity in two ways: First, the irritant increases the hypertrophy of the soft parts; secondly, the nail grows more rapidly in moist media. The nail in some cases has been found to have grown almost, if not quite, through the toe. On the other hand, the hypertrophic tissue has been observed as large as the end of the toe itself. If one had an inflammatory surface on any portion of his anatomy, he would not constantly irritate it to cure it. Rest would be demanded. The further the foot slips forward the greater the pressure upon the toes, the greater the pressure of the soft parts against the nails, the greater the liability to the development of ingrown toe-nail, and the more pressure it receives the faster both the nail and the soft parts grow. If this argument is correct, to have normal toes, and the comfort that comes from the unconsciousness that we have these organs, we must have footwear that will carry out the other proposition, viz: have shoes fit so well about the vamp that the toes cannot slide forward.

In certain skin diseases and nervous affections there is an irregular growth of the nails, and conditions very much resembling ingrown nail may be present, which are not due in those cases, however, to ill-fitting shoes.

**Bunion** and the result, **hammer toe**, are very closely akin to ingrown toe-nail etiologically. The same causes may be enumerated, viz: narrow-toed and loose vamp shoes. As a result of a study of quite a number of feet afflicted with these deformities, it has been found

that bunion and hammer toe go hand in hand, the narrow-toed shoe causing the great toe to override the second. The tendon of the flexor longus digitorum attached to the last phalanx of the second toe is gradually shortened, and eventually permanent contraction is present; compensatory at first, but eventually becoming fixed. The space left by the turning under of the second toe, or by the displacement of the end of the second toe by the crowding in and overriding of the great toe, is filled permanently by the end of the great toe taking up its residence where that of the second should be. A perfect foot should conform to Meyers' line. This is a line drawn along the plantar surface of the foot through the center of the heel and the joints of the great toe. As may be observed, when the second toe is flexed into a hammer toe, and the great toe turned in to occupy the space thus made, there must be some change in the angle of the articular surface of the tarso-phalangeal joint of the great toe. By studying the outline of Fig. 15, which represents a normal foot, you will observe that Meyers' line, bisects the long axis of the phalanges and tarsal bone of the great toe. Comparing this, you will observe that Meyers' line falls outside of the great toe almost entirely. This diagram is not theoretical, but is taken from a case. Nature's tendency to fill vacuum is observed in this case, and the angle left between the bones named is filled by provisional callus, which eventually enlarges the head of the tarsal bone so as to make a perceptible deformity known as a bunion. It must be remembered that this deformity does not come on in a few weeks or months, but that years are required to produce it.

Treatment for (*a*) ingrown toe-nail, (*b*) bunion, (*c*) hammer toe, is

1. Preventive—low heel shoe, tight vamp, roomy toe; 2. Medicinal; 3. Mechanical; 4. Operative.

**Preventives** may be considered in common for the three conditions, for what produces one enters as a factor in the production of the others. The ounce of prevention is worth ten pounds of cure. As heretofore indicated, proper-fitting shoes will act as a guard against the production of a great many of these deformities. Parents should see to it that the toes do not slip down against the toe of the shoe; and also that the toe is wide enough, but not too wide. This will be the case if the shoes do not fit across the instep snugly. Pressure upon the toes by shoes will cause ingrown toe-nails. The same pressure will cause the toes to override each other, and hammer toe and bunion result. A tight vamp prevents the foot from sliding forward, and a low heel affords the same protection, and less tension is made upon the vamp, making the foot more comfortable generally.

For **ingrown toe-nails** much has been said and written regarding treatment. Lotions of all forms have been suggested. The nail has been elevated and held up with cotton. It has been torn out, scraped through the center, and angular sections removed. The hypertrophic soft parts have been strapped down, and it has been sliced off. The treatment which has served the best and produced the most permanent result in my hands may be summarized as follows: Under chloroform, ethyl chloride, cocaine or ice anesthesia, cut the nail through the center with a pair of sharp scissors. Tear the nail out with a pair of dressing

forceps; remove a wedge-shaped piece of flesh, the incision being made close to the bone, and beginning at the end of the toe near the skin, running backwards

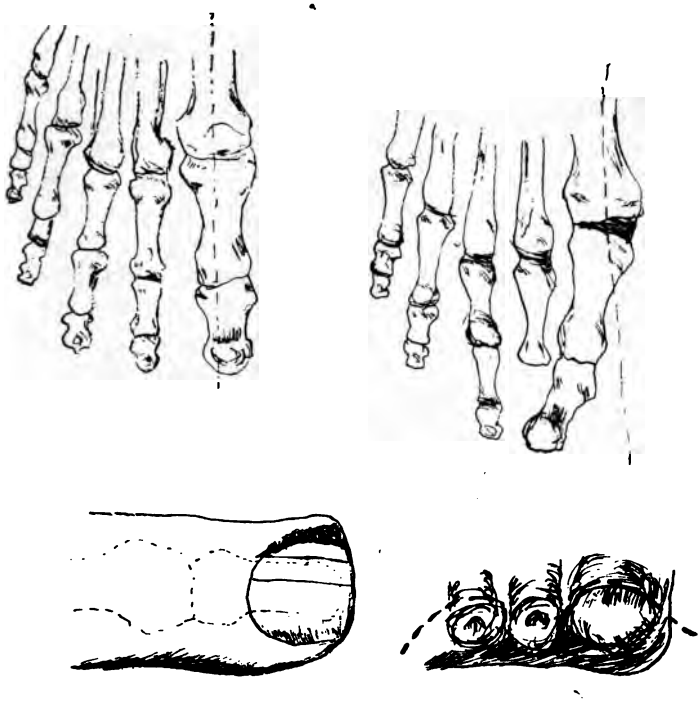


FIG. 15.

SHOWING NORMAL TOE; AS FOUND IN BUNION; OPERATION FOR INGROWN TOE-NAIL; AND A SUPPORT FOR HAMMER-TOE.

to join the posterior end of the first. This removes a wedge-shaped piece of flesh which includes the diseased structures or the portion which has been irritated by the

nail. The end of the flaps are brought down and stitched together, leaving the outline of the toe normal. The operation removes the hypertrophic soft tissue and the elongated nail, and avoids a raw surface by stitching the flap to the inside of the toe, which otherwise would have to heal by granulation.

**Hammer-toe** requires, first mechanical support or, second, amputation. Mechanical support consists of either holding the drooping end of the toe up by passing a piece of plaster under it and over the top of the great and third toes (see Fig. 15), or the toe may be supported by a splint underneath and strapped down to same. In case the flexion of the second toe is not very great it can be held straight by wrapping a strip of Mead's adhesive plaster around it without passing the ends over the other toes. To effectually cure a hammer-toe is to, first, cure the overriding great toe. Of course, these two conditions are not invariably associated, but in marked cases this association exists in about 90 per cent.

**For Bunions** mechanical devices have been used to draw the great toe around to Meyers' line, the best of which is Biggs' apparatus. This will draw the toe around, but if, as has been argued, there is an enlargement of the internal portion of the head of the tarsal bone, little can be expected by mechanics, unless they be continued for some time. The pressure thus caused will promote absorption of the bone, and unless this absorption does occur no permanent good can be expected. The very moment the great toe is returned to Meyers' line, the hammer-toe will return to its normal position unless the condition has existed so long as to produce perma-

nent shortening of the flexor longus digitorum, in which case tenotomy should be performed and *brisment force* used to break up ankylosis of the second joint.

For *hullux valgum*, or bunion, operations offer much in the way of permanent relief. Under an anesthetic an opening is made down to the bone over the most prominent point of the bunion, avoiding the joint cavity. After peeling back the periosteum, the bone is chiseled away until all abnormal enlargement is removed. In case it is found that the angle of the articular surface has been changed, a cuneiform osteotomy should be performed, removing a wedge-shaped piece of bone from the metatarsus, the apex of which must reach through the bone far enough to admit of fracture and straightening.

Robert F. Weir suggests a method of curing *hallux valgum*, by the removal of a wedge of bone including the

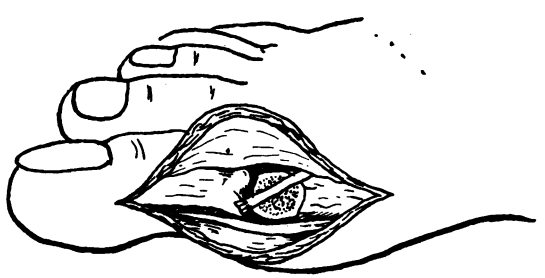


FIG. 16.—WEIR'S OPERATION.

epiphysis of the metatarsus of the great toe. He is particular to cut all tissues which prevent the toe from standing parallel with Meyers' line without assistance. He enucleates the sesamoid bones when found. The proprius pollicis is cut at its insertion and sutured to

the inner and lower portion of the first phalanx of the great toe. He makes a circular incision around and below the tumor so as to have the scar at a point which will receive the least pressure by the shoe after repair.

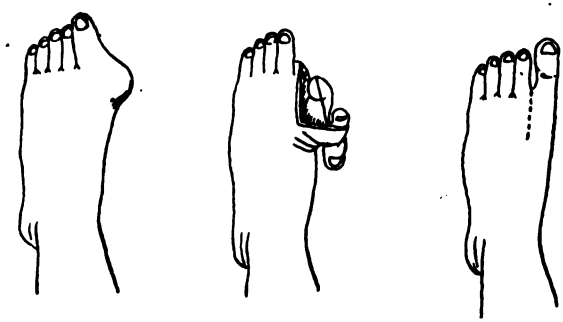


FIG. 17.—FOWLER'S OPERATION.

Fowler advises that the incision be made between the first and second toes, the great toe disarticulated and turned out and the hypertrophic bone removed, after which the toe is returned to its new position and sutured.

## DEFORMITIES OF THE HANDS.

Classification of congenital deformities of the hands which appears to be most rational is :

**First,** deficiencies; *second*, supernumerary digitis; and *third*, abnormal development.

Under the *first* head we have absence of fingers or toes, or of parts of the body, and of the hands and feet and absence of long bones.

Many cases of inter-uterine amputation of an entire extremity are recorded. In a case seen recently, a child was born without an arm, due to a fright the mother received during early gestation. She saw a man thrown in front of a locomotive and the wheels ran over one of his arms, severing it.

In another case a wife of a railroader who was three months pregnant, saw some men carrying a stretcher toward her house, and she immediately concluded it was her husband. As was a habit with her when in trouble, she grasped her left fingers and thumb well up to the knuckles with her right hand with considerable of firmness. The writer has seen the child, and the thumb and all the fingers are amputated midway between the knuckle and next joint.

Congenital absence of parts, or entire long bones, is not a frequent variety of deformity. This may be properly considered as one of the conditions producing a variety of club-hand and club-foot.

Absence of the radius or ulna, or tibia or fibula, will produce distortions characteristic of the defect.

Dr. Wirt reports a very interesting case of congenital

deformity which, he says, presented a condition of double club-foot, double club-hand, imperfect development, and imperfect action of both ankles, knees, hips, elbows and wrists. In the hands there were contractures of all the fingers, so that in this child there was not a perfect acting joint in either the upper or lower extremities, except in the phalanges of the feet. The feet were in extreme equino-varus. The knee joints and patellæ were rudimentary, and the latter displaced externally. The ends of the bones were smaller than they should be, and were irregular. The legs were held extended, and could only be flexed through an angle of thirty degrees; the latter part of this flexion caused a crackling noise distinctly audible. The ligaments were lax, permitting nearly as much lateral motion as flexion. There was some knock-knee present. The thighs were flexed and rotated outward. By force they could be flexed to 110 degrees and extended to 165 degrees. Rotation was limited to one-half the normal arc. Abduction was permitted to but a small extent: adduction was somewhat greater. The obstruction to motion in the lower extremities seemed bony and ligamentous, and not muscular or tendinous. The right limb was shorter than the left, and on the right side the trochanter major was three-fourths of an inch above Nelaton's line. There was evidently a congenital dislocation of the hip on the right side. At the shoulder and elbows the condition was very similar to that at the hips and knees, with the difference that there was more motion permitted in the upper extremities, and the obstruction was more of a muscular character and less bony. The pectoral muscles were strongly contracted. There was marked double club-

hand, with imperfectly developed wrists. The hands and fingers were flexed with adduction at the wrists. The flexion in the fingers was due to contracture of the palmar fascia.

Kœnig reports forty-five cases of congenital absence of the radius, and in twenty-one the defect was bilateral. In only two were the thumb and metacarpal bones well developed. In the great majority of cases the child was both premature and still-born, and seldom lived but a few weeks. Nearly always other defects were present in other parts of the body.

Dr. Sayre reports one case, and Dr. A. E. Taylor, of Philadelphia, reports another case of congenital absence of radii by letter to the author.

Bardenheuer describes an operation for this deformity as follows: "A longitudinal incision is made over the distal end of the ulna and the carpus, and the first isolated from its attachments. The ulna is then split through its middle into a radial and ulnar section. These are separated by allowing the carpal bones to come between them, and are secured in position by nails through the ends of the bones into the carpus." He claims to have had good results in operations upon the tibia and fibula, as well as for congenital defects of the radius and ulna.

B. E. McKenzie, of Toronto, reports nine cases of congenital defect of long bones.

The following case is reported to illustrate one variety of the defect and the operation for its relief:

CASE 2.—Mildred G., referred by Dr. J. F. Baldwin, of Columbus, was born at full term perfectly developed, except that there was complete absence of the radii, with abnormal relationship existing in the blood vessels and soft structures of the forearms. (See Fig. 18.)

March 1, 1895, when the babe was five months old, the following operation was performed: The soft structures, tendons, etc., were so much shortened that to attempt to shift the end of the ulna across to the center of the carpus would have been impossible except by a virtual amputation of the arm. To have split the ulna and wired the carpal bones between these ends, as Bardenheuer suggests, would have been impossible. The only method that appeared to me to be possible was to sever the

FIG. 18.

CONGENITAL ABSENCE OF RADII.

ulna at a point where the free end of the upper fragment could be brought to the semilunar, which was done. The semilunar was curretted and drilled, and after drilling the ulna these bones were adjusted with silkworm gut. It was necessary to tenotomize the tendons, etc., upon the radial side of the forearm before the hand could be straightened. A number of arteries were severed and required ligation. The incision through the soft tissues was made obliquely across the forearm, beginning upon the dorsum of the wrist upward, and around

under the forearm, the object being to allow the structures to slide upon each other, and then sutured in the corrected position, thus avoiding the gap that would otherwise be left after a cross section. After dressings were applied the hand was put up in plaster-of-Paris. There was quite extensive hemorrhage, and it was necessasy to redress the arm in twenty-four hours. The next dressing was made in two weeks after the operation and primary union had occurred. The operation was done on the left hand, and a second operation was planned for the right arm, but the patient died with pulmonary tuberculosis five months afterward.

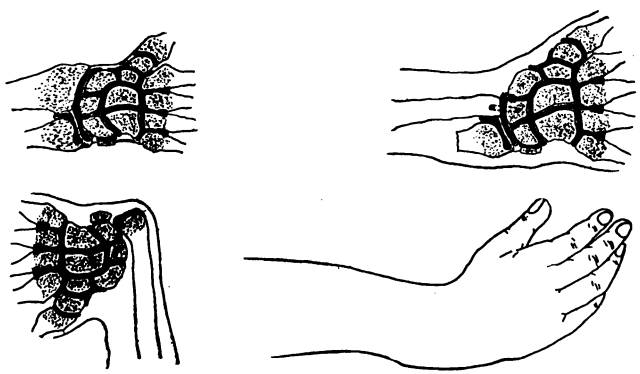


FIG. 19.—ILLUSTRATING CASE 2.

Such an operation would, of course, destroy the second sac of the wrist joint, and, assuming that the third synovial sac was normal, the wiring of the free end of the ulna to the semilunar would not destroy this sac, and we could hope that union between these bones would allow the flexion and extension at the wrist, as would be permitted by a healthy third sac.

### CLUB-HANDS.

As in club-foot, club-hand may be considered a distortion of the hand in any direction from the normal position, or interference with the normal range of flexion, extension or rotation.

**Varieties.**—Deformity is in the direction of flexion (palmar), extension (dorsal), abduction (ulnar), and adduction (radial). There may be a combination of any two of these varieties, as in club-foot, when they are known as cubito-palmar, radio-palmar, radio-dorsal and cubito-dorsal.

**Frequency.**—Tubby says that there are three cases annually in the Royal Orthopedic Hospital and four in the National Orthopedic Hospital, but he does not say what percentum this is of cases seen.

**Symptoms.**—The relationship of the hand to the forearm is changed, the degree of deformity depending upon the extent of contracture. The electrical reaction is diminished, and where there is extensive atrophy it may be absent.

**Treatment.**—The mild cases are relieved by passive movements, massage, electricity and retaining appliances, but in severe cases tenotomy and bone operations will be necessary. Since the extent of deformity or amount of defect is so various, no fixed brace can be described as a retentive. The ingenuity of the orthopedic surgeon, both as to braces and operation, must come to the rescue. Plaster-of-Paris is an admirable corrective, and may be used as a retentive after operations. The same rules which govern club-foot operations should prevail here, viz: cut such tendons or structures as offer resistance until the hand can be super-corrected, in which position it is held by mechanical appliances until correction is permanent.

Under the *second* variety we find the *supernumerary digits*, ranging from a rudimentary nail on a thumb or finger to as high as thirteen fingers on each hand and twelve toes on each foot.

The following family is reported to illustrate the second variety, representing *three generations of six-fingered anomalies.*

FIG. 20.

SIX-FINGERED FAMILY.

H. B., aged 40, (see Fig. 20). Has six fingers on each hand and six toes on each foot. He is the father of eleven children deformed as follows :

First, son, six fingers on each hand—dead.

Third, son, six toes on each foot—dead.

Seventh, son, (see Fig. 20), six fingers on each hand.

Eleventh, daughter, same as father, viz : six fingers and six toes on hands and feet.

A sister of H. B. also has six fingers on the left hand, and had one daughter with six fingers on right hand. A brother of H. B. had two nails on a very broad left thumb. The father of H. B. had right thumb like a finger with a defect in the nail very much approaching two nails, but no cleft existed in the skin. It will be observed that instead of a thumb there are two perfect fingers, with the bones and joints arranged as are the other fingers.

**Treatment** consists in the removal of the extra digits.

The *third* variety includes bifurcation of the hand and perverted development of the hands and feet, and abnormal arrangement of the parts.

**Webbed Fingers** and toes, is where there is, as a rule, the proper number and arrangement of the digits, but they are bound together by a webb which may be very slight, or may extend to the tips of the digits. This is the most common of the congenital deformities. It may be, and frequently is, associated with supernumerary digits and deficiencies of other parts.

The treatment of webbed fingers consists in severing the band of union by the Didot method, *i. e.*, dissecting a flap from the palmar surface of one finger for the dorsal surface of the other, and vice versa. The dissection is made between the fingers from the edge of the flap thus separating them. The flaps are drawn through between the fingers and sutured, (Fig. 21). Zeller's and Norton's operations are to be preferred in some varieties of deformity. For deficiencies of fingers or parts of hands, a substitute of rubber, wax or other material will restore symmetry and greatly improve the appearance of the member.

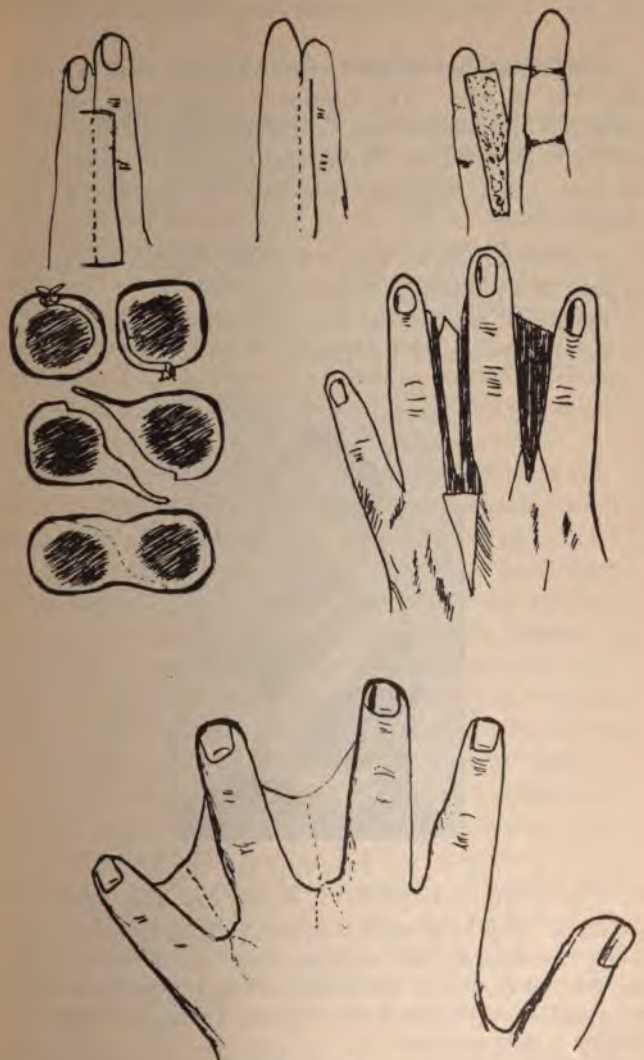


FIG. 21.

OPERATIONS FOR WEBBED FINGERS.

**Congenital Contractions** and hypertrophy of fingers and toes is rare. The former is dependent upon dislocations or deficiencies in development of the bones of the fingers or toes. Contractions require tenotomies, or such other operation as may be selected by the surgeon.

Hypertrophies, as they are found in the extremities, appear as abnormally large digits.

Treatment consists in amputation or other operation to reduce the size of the parts.

FIG. 22.

CONGENITAL DEFORMITY OF OF THE FOREARM.

CASE 3.—Fig. 22 shows a congenital deformity of the forearm. There is no elbow joint, the lower end of the humerus and the upper ends of the radius and ulna being fused. The wrist and shoulder joints are normal. Father is a Chinaman and the mother a mulatto.

Operative interference was not advised, since she can reach her mouth, and the hand is more useful than in a straight position.

## DUPUYTREN'S CONTRACTION.

**Dupuytren's Contraction** is a permanent flexion of one or more fingers as a result of contraction of the palmar fascia and its digital prolongations.

**Sex.**—Keene reports 227 cases, 180 of which were men. Noble Smith reported 70 cases with 55 men.

**Age.**—It is a disease of middle and advanced life. Tubby reports one case at 16, and one at 28 years, and the writer has one case at 16 years old.

**Heredity.**—Keene found hereditary history in 25 per cent. and reports three families who had the deformity through three, and one through four generations.

Occupations which produce slight concussion, or contusions of the hand, as occur in carpenters, machinists and artisans who handle tools, were thought to be most frequent causes, but more recent investigations show that professional men, and those who do no manual work, are most frequently the victims of this disease.

Gout and rheumatism are given as causes, and Abbe thinks it is due to a lesion in the central nervous system. Bradford and Lovett found sugar in the urine of the majority of these individuals. A slight traumatism occurs, often entirely forgotten, then a spinal impression, produced by this peripheral irritation, succeeded by reflex influences on the part originally hurt, producing in its turn pain, hyperemia, hypertrophy, and contraction of the bands of the fascia; and an occasional joint lesion simulating subacute rheumatism. The following table is found in Tubby, which shows the individual fingers affected, in 297 cases recorded by him: Thumb, 9; forefinger, 13; middle finger, 45; ring finger, 88; little finger, 77; ring and little, 65.

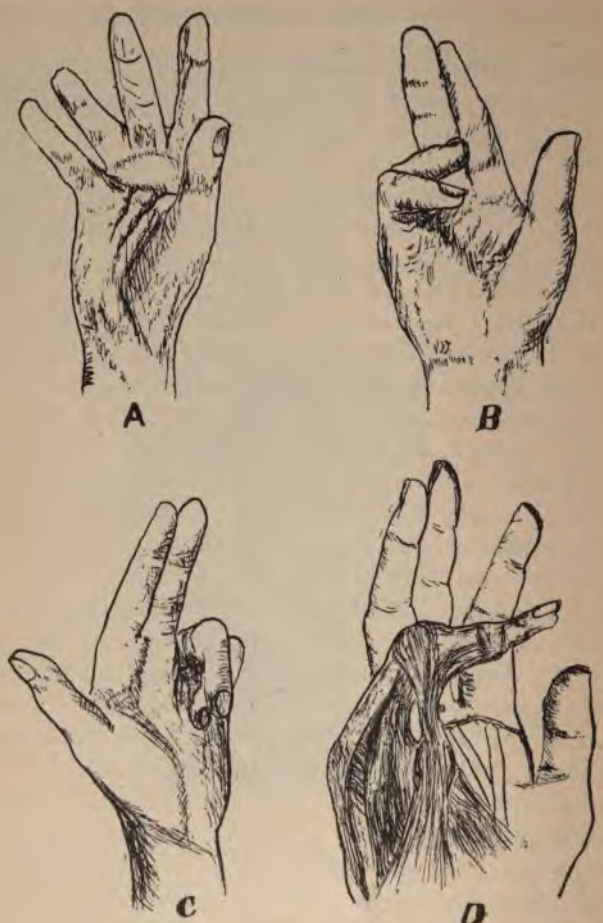



FIG. 23.

A. FIRST STAGE OF DUPUYTREN'S CONTRACTION. B. SECOND STAGE. C. THIRD STAGE. D. DISSECTION OF THIRD STAGE.

**Pathology.**—The fingers are drawn into the palm of the hand by a contraction of the palmar fascia primarily, and of the skin secondarily. The tendons are not factors and remain free below. Small shot-like bodies are found along the contracted fascia. The accompanying cuts show the three stages of contraction, and the fourth a dissection of a case in the third stage. (Fig. 23.)

**Symptoms** are feeling of contraction in the palm of the hand, beginning generally in the ring and little fingers, associated with a sensation of cramps with some pain. The skin at first is free, but later on it becomes attached to the contracted fascia and a dimple is found at this point. A shot-like enlargement can be felt along the contracted tissue in advanced cases. The first phalanx is drawn towards the metacarpal first, and this is followed by the second being drawn on the first. The third or distal joint is seldom involved in the contraction. As a rule the progress is slow, extending over some years.

**Diagnosis** depends upon the presence of forced flexion of the fingers, coming on gradually ; the absence of pain, ankylosis, scars as evidence of former injury or burns, and of cerebro-spinal symptoms.

**Differential diagnosis** must be made from congenital contractions, from the contractions as a result of nerve injuries and injuries to the muscular and osseous systems, and from deformities following osteomyelitis.

**Prognosis** is favorable under operative methods, but without this nothing definite can be promised.

**Treatment** is subdivided into medical, mechanical and operative. Medical treatment is of no value, and mechanical treatment accomplishes nothing except to

temporarily check the advance of the deformity. Operative treatment consists in a division of the contracted tissue, either subcutaneously or by the open method. The subcutaneous operation, as suggested by Adams, is to be preferred when possible. His method is to enter a fascia knife between the skin and fascia, and cut the latter in several places. This requires several punctures. The operation should not stop until all contracted tissue has been severed, and the fingers can be restored to complete extension.

The open method consists in first dissecting a V-shaped flap of skin from the palm immediately over the contracted tissue with the base toward the wrist. The contracted tissue is now dissected out. The subcutaneous operation is to be preferred, as sloughing, sepsis, and cicatricial contractions are liable to follow the open method. The subcutaneous operation may be done under ethyl chloride or cocaine. Retaining appliances after operation consist in moderate extension for a few hours, after which time the fingers may be completely extended.

**Case 4.**—H. T., aged 16. received injury two years ago by having a nail driven through the hand external to the fifth metacarpal. It remained sore for three months. About a year ago, while at school, the contraction of the fascia was so severe as to acquire medical attention. It was kept in splints for some time, but no benefit resulted from the treatment. While the hand is not used there is comparative comfort. The use of a pen or other small object increases the spasm.

### SNAP FINGER.

**Snap finger**, sometimes called spring finger or mallet finger is due to some obstruction to the free movement of the tendon in its sheath, by adhesions from tenosynovitis in the annular ligament, or in the region of

the wrist, or it may also be caused by a ganglion or wrist disease. When the finger is extended it flies against the palm of the hand as a knife blade closes. (Fig. 24.)

Treatment consists in removal of the ganglion, if this is the cause, or in the proper treatment for other pathological changes; forcible extension and retention by a splint is necessary. Tenotomy is not advisable, except in very extreme cases.

FIG. 24.

MALLET FINGER—(AFTER TUBBY).

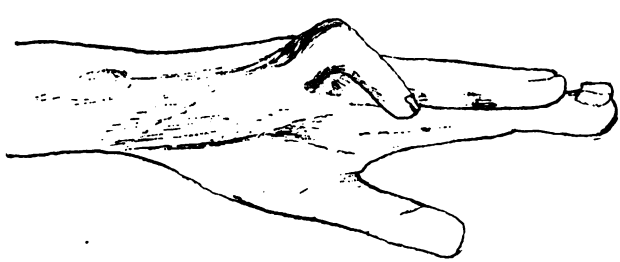


FIG. 25.

CONGENITAL CONTRACTION OF LITTLE FINGER—(AFTER TUBBY).

Morris of New York says snap finger is due to a thinning and a longitudinal separation of the fibres of the extensor tendon as it passes over the last phalangeal articulation. He advises as treatment that a longitu-

dinal section be made through the skin over the joint. The tendon is now divided longitudinally and cut transversely at the thinnest point. These fasciculae thus formed are advanced on their own side of the finger, the proximal ones being stitched to the under surface of the skin as near to the nail as possible and the distal tendons sutured in the same manner on the opposite side of the joint. The sutures are tied on the outside of the skin.

### DEFORMITIES FOLLOWING NERVE INJURIES.

**Contraction of the Forearm and Wrist** may result from injury of the brachial plexus, as a complication of fracture of the clavicle or dislocation of the humerus, or other nerve injury associated with fracture or dislocation of the arm or forearm, or injury to the soft parts.

Nerve injuries result in a variety of deformities of the hands, many of which are greatly benefited by operative treatment.

Nerves are included in cicatrices after injury and ulcerative processes, which, if liberated, or pressure is removed, the paralysis disappears and resultant deformity overcome.

As associated symptoms, there may be atrophy or paralysis of the entire arm, or of groups of muscles.

Fig. 26 represents a deformity of the hand following ulnar nerve injury, and Fig. 27 median nerve injury.

An interesting and gratifying case of deformity has been under observation as a result of an injury to the flexor muscles of the forearm. There is marked contraction of the *flexor sublimus digitorum*. When the wrist is flexed to almost a right angle, the fingers can be extended; but when the wrist is made parallel with

the forearm, the fingers cannot be extended, but remain flexed upon themselves.

**Treatment** consists in removing pressure upon the nerve if possible by an open operation, and tenotomy of contracted tendons; restore the member to a normal position and retain it there by plaster-of-Paris, or other splint.

FIG. 26.

ULNAR NERVE INJURY—(AFTER TUBBY).

**Operation** consisted in tenoplasty to make it longer as per the Czerney method, which permitted extension of the fingers and wrist at the same time.

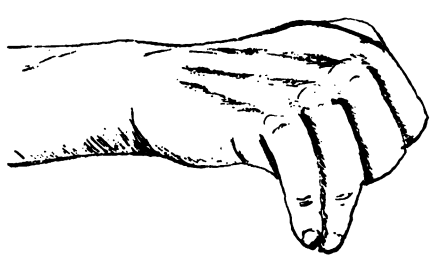


FIG. 27.

INJURY OF MEDIAN NERVE.

## TUBERCULAR BONE AND JOINT DISEASES.

**General Consideration.**—Introductory to the chapters on tubercular bone and joint diseases, it is thought advisable to consider this subject in a general way, so as to avoid repetition, as the various diseases are separately taken up.

The primary focus of inflammation may be located in: first, bone; second, synovial membrane; third, cartilage; fourth, periarticular structures; and may secondarily involve any one, or all of the above structures.

Synovitis is most frequent in adults, while primary epiphysitis is most frequently found in children from five to twelve years of age.

Chronic epiphysitis of children is generally tubercular, except in those cases where a history of syphilis can be obtained. Occasionally epiphysitis runs a very rapid course, when it must be considered osteomyelitis due to streptococcus infection.

These conditions have been described under the heads of white swelling, tumor albus, scrofulous joints, tubercular joints, chronic articular ostitis, epiphysitis, and caries of joints.

Since it is now accepted as being tubercular, the above names must be discarded for *tubercular bone and joint disease.* It is a chronic condition with gradual onset, resulting from slight injuries during a reduced condition of the system, when the bacillus of tuberculosis makes a successful attack upon, and destroys

the leucocyte. It very rarely follows fracture, dislocation, or severe injury. According to Gibney, ninety-nine per cent of all cases of joint disease have a tubercular history. The majority are in children, and one-half under twelve years of age.

Studies of the *blood* in cases of tubercular bone and joint diseases, have been made by Dane of Boston, and Brown of San Francisco. The former analyzed the blood of 43 cases, and makes the following deductions :

"1. Most cases of tuberculosis of the bones and joints do not decrease the number of the red corpuscles in the blood.

2. They do, however, affect the percentage of hemoglobin, giving rise in fact to a mild degree of chlorosis.

3. The leucocyte count seems to bear no direct relation to temperature.

4. High counts, especially in hip disease, point to the probability that there is, or shortly will be, an abscess formation ; but low counts do not preclude the presence of abscess, especially in cases of long standing.

5. Where, in connection with a low leucocyte count, an abscess is found to exist, the pus from it is sterile, and the case is generally one of long-standing.

6. In the presence of an abscess, a low leucocyte count generally indicates the absence, and a high count the presence, of a secondary infection with pyogenic organisms.

7. Cases where, at the primary operation, the pus has proved sterile, show an increase in the leucocyte count where the wound becomes infected with pyogenic organisms.

8. High leucocyte counts do not always affect the differential count.

9. Cases with a traumatic origin are generally accompanied by a high leucocyte count and run a more severe course. This is especially shown in cases of hip disease, where nine gave a fairly clear history. One case is interesting in this connection, for it breaks into the series of cases with a high leucocyte count that failed to produce an abscess, but even here the severity of the disease was shown by the stubborn persistence of the night-cries under the recumbent form of treatment. That more of the cases which entered with a developed abscess did not give a definite history of trauma is due no doubt to the fact that the length of time the disease had been progressing had caused a lack of accurate detail at the beginning being remembered. The clinical side of this is alluded to by Watson Cheyne in his latest work."

Dr. Brown's studies included analysis of the blood of 73 cases, and he concludes his paper as follows :—

"1. No decrease in erythrocytes except in secondary anemias of second and third stages, which come (*a*) in long-standing and extensive cases, (*b*) in very young children, and (*c*) in septic infections.

2. Hemoglobin is decreased in all cases, and in proportion to the same factors which influence the erythrocytes.

3. The return to health is indicated by the tendency of blood to return to the normal.

4. Abscess formation not necessarily accompanied by leucocytosis. Slowly developing leucocytosis points to activity in the tubercular process. Rapidly developing leucocytosis points to secondary infection with

pyogenic bacteria. Abscess may be absorbed without a leucocytosis having developed.

In septic infections of wounds, leucocytosis is marked at first, and diminishes as the resistance of the child increases or decreases. If the diminution is accompanied by an increased anemia, it is a sign of the lowered vitality of the child."

**Pathology.**—There is usually a contusion of the spongy structure of a bone, as the condyles, or head of the femur, body of a vertebra, which is accompanied by laceration of blood vessels, effusion into surrounding tissue, at which time bacterial invasion occurs.

FIG. 28.

TUBERCULOSIS SHOWING SEQUESTRUM.

The hyperemic area changes to a gray color, which may, later on, become yellow. The spot is surrounded by a hyperemic zone, which enlarges as the central gray mass increases in size. Innumerable miliary tubercular masses are found around the central mass, which soften, and the cancellous structure is destroyed, leaving a cheesy mass, which may contain one or many sequestra. (See Fig. 28.) This is followed by eburnation of the bone surrounding the cavity.

As it involves the synovial membrane or soft structures, there is extensive formation of a growth known as *granulation tissue.* The growth may be quite exuberant when it is known as fungous joint.

**Bacilli** are carried from one part of the body to another through the lymph channels and blood vessels. They are more numerous during the early course, and have disappeared when degeneration takes place and are almost never found in abscesses. The tendency of the bacillus of tuberculosis is to develop in the ends of the long bones. Secondary deposits develop in about twenty-eight per cent. of cases. The primary focus may be in the hip, with a secondary focus in the knee, elbow or body of a vertebra, or in the lungs, meninges, or mesentery.

The *termination* may be absorption and cure, or *caries sicca;* or it may be suppuration, or *caries necrotica,* which is the result in about fifty per cent. of all cases. The liquid may break, first into the joint, or through the periosteum, into the peri-articular structures external to the joint. Wedge-shaped or round masses of bone may be found in the center of the epiphysis, or the entire epiphysis may become detached. New bone or involucrum is developed, resulting in the condition known as *spina ventosa.*

**Symptoms** are wanting in the early stage. Pain, when present, is in the nerve terminals remote from the bone. Later, there is a slight elevation of temperature in the afternoon, below 100°, and lasting for an hour or so only. The joint becomes uniformly enlarged, and may be red or white. The veins of the extremity are usually dilated. When pain becomes severe, active suppuration is going on, and when such pain suddenly diminishes it is

evident that the liquid has made its escape from the bone into the joint or surrounding tissues, or that pressure has been relieved.

**Differential Diagnosis.**—The one condition constantly mistaken by the general practitioner for bone and joint disease is *rheumatism*. About half of these cases, when they reach the surgeon, have been called and treated for rheumatism, and even after a sinous has formed the claim is made that the rheumatism has gone to the bone. When pain is localized and is deep-seated, and is found in no other joint, tubercular synovitis or epiphysitis must be suspected.

**Prognosis** is more favorable in children. In adults there is more tendency to *caries necrotica*. It may heal spontaneously, and is considered a self-limited disease. Mortality is about twenty-four per cent., patients dying from mixed infection, from discharging sinuses, secondary infection of the lungs, amyloid degeneration of the viscera, and deposits in other structures. These cases are under treatment from one to six years, and may relapse after many years.

**Treatment** will be considered as the several joints are taken up, but it may be tabulated for diseases of the knee, wrist, ankle, elbow and other joints near the surface, as follows :

1—Quiet. Immobilization.

2—Glycerine paste.

3—Iodoform injections into diseased tissues.

4—Traction, when it affords relief.

5—Generous diet.

6—Medication. Iron and iodide of potash.

**Tubercular Abscess.**—In about half of the cases of tubercular bone and joint disease the tendency is

toward liquefaction, or *caries necrotica;* while in the remaining cases the disease runs its course, and the focus of tubercular infection, while it may liquefy, instead of coming to the surface, the liquid portion is absorbed, and there remains a possible sequestrum, a cheesy mass, or the former imbedded in the latter, both of which are surrounded by an eburnated area of bone, which protects the diseased area from injury, as well as retards the process of absorption, thus preventing secondary deposit. As has been stated, the product of tuberculosis is not pus, for the reason that it does not contain pus cells, and is only pus when we have mixed infection, or when pyogenic bacteria have gained entrance to the abscess cavity either through the system or through a sinus. The product of tuberculosis, or what has been known for years as a cold abscess is, as a rule, harmless. It may become a source of danger, by making pressure upon blood vessels, nerves, or upon important viscera.

The question, however, of the management of tubercular abscesses is not settled. The operating orthopedic and general surgeon unhesitatingly opens all tubercular abscesses regardless of their course or source, and regardless of the danger of mixed infection, secondary deposits, and possible systemic disturbances. The conservative orthopedic surgeon, on the other hand, sees no harm in the presence of these liquid accumulations when they are running a harmless course, producing no local disturbances and no constitutional ill-effect, and concludes that it is only when special demand is made by grave symptoms that they should be operated. *Local* reasons for operation are present when the abscess is very large, the walls are very thin, and

spontaneous opening is inevitable, or if the abscess is making pressure upon, and destroying the function of other structures or organs. The *constitutional* changes which demand the liberation of a tubercular abscess are the existence of grave symptoms, as chills, fever, emaciation, and other evidences of systemic infection. In such cases the liberation of the abscess is generally followed by cessation of acute symptoms. The abscesses *burrow* in the direction of the least resistance, generally along the sheath of muscles that have their origin or insertion near the seat of the abscess. They may also gravitate along blood vessels, nerves or bones. They point where the structures just mentioned come the nearest to the surface.

As a local applicant to tubercular abscesses nothing appears to promote the absorption of the liquid portion, and under its continuous use, prevent enlargement and further extension, and eventual spontaneous eruption, so well as an ointment made as follows :

℞

Aristol, ℥i;
Lanolin, ℥i.
Apply twice daily.

The application should be made under gentle heat immediately over the abscess, and continued under friction for at least ten minutes.

The management of abscesses as they appear as complications of the various tubercular bone and joint diseases, will be considered under the various special heads.

TOPOGRAPHY OF BONE AND JOINT DISEASE.

| TABLE (SENN) | PER CENT. |
|---|---|
| Spine, | 23.2 |
| Knee Joint, | 16.5 |
| Hip Joint, | 14.6 |
| Tarsus and Ankle, | 14.4 |
| Elbow Joint. | 6.3 |
| Wrist and Hand, | 6 |
| Skull and Face, | 5.5 |
| Sternum, Clavicle and Ribs, | 5.2 |
| Pelvis, | 3.5 |
| Femur, Tibia and Fibula, | 3.5 |
| Shoulder, | 1.5 |
| Scapula, Ulna and Radius, | 1 |
| Humerus, | 0.8 |
| Patella, | 0.1 |

## KNEE JOINT DISEASE.

This disease, also known as *tumor albus*, is a chronic tubercular disease of the epiphyses of the bones entering into the formation of the knee joint or of the soft structures.

**Age.** It occurs most frequently from the ages of eighteen to twenty-five, although it may occur at any age. Of all knee-joint affections, forty-nine per cent. are synovial and fifty-one per cent. osseous. Epiphysitis is more frequent in children, and synovitis more frequent in adults.

The pathological changes are the same as are found in other tubercular diseases. The primary focus is found most frequently in the internal condyle, patella, and fibula. The causes are the same as those which produce hip and other tubercular bone diseases.

**Stages.**—Three stages are recognized :

1. Incipient stage, during which time local destruction of bone takes place and pus formation begins.
2. Acute stage, or the formation of abscess outside of the joint and destruction of the joint.
3. The latter stage, during which time repair and recovery occurs, or destruction, excision, amputation or death takes place.

**Symptoms.**—During the first stage we find stiffness, limping, slight pain, languor, with possibly slight flexion. No great alteration in general health occurs. The onset is gradual. The rigidity of the joint is caused by the effort of nature to protect the diseased

area, resulting frequently in slight flexion, producing lameness.

**Pain** is at first intermittent, and is described as an ache, or a tired feeling in the leg, which is increased by exercise and disappears after rest.

**Swelling,** which soon follows, is soft and elastic, and a general tumefaction of the joint is found, which is particularly marked over the internal condyle, and is quite characteristic of this disease. (See Fig. 29*a*.)

**Tenderness** is elicited over the internal condyle just internal to the patella. Local heat is, as a rule, present, but high temperature is only found before abscess eruption. When cases run a very chronic course, local temperature may be absent. The color of the skin either retains its normal hue or becomes blanched; hence the name *tumor albus*. The superficial veins over the joint become distended.

The *second stage* is characterized by an exaggeration of the above symptoms. The pain and spasmodic contraction of muscles appears at night, producing the usual *night cries* of tubercular bone disease. The tenderness or soreness of the joint increases, and in some cases the pain and sensitiveness is quite severe, or even intense, which is increased during exercise or motion of the member. Abnormal movements of the joint are now present, due to the destruction of ligaments and relaxation of muscles.

Crepitation is evidence of the destruction of the cartilage covering the ends of the bone. The latter symptom, if absent, is evidence of the formation of granulation tissue on the ends of the bone.

During the *third stage* resolution takes place in the joint and ankylosis occurs, with, as a rule, the knee in

subluxation, or complete destruction of the ligamentous structures and the epiphysis takes place, requiring excision, and when the destruction extends to the shaft of the bone, amputation is demanded, unless the process of repair is so far advanced that *spina ventosa* is sufficient and the dead bone can be enucleated. Muscular atrophy is found in all cases in the course of a few weeks from the onset, which increases as the disease advances. (For abscess, see former pages.)

During the progress of the disease, which may take months, the general health of the patient gradually fails. Emaciation, sleeplessness, exhaustion from fever, etc., are usual in the third stage, and death may result from these causes or from secondary involvement of the viscera, or other structures.

**Diagnosis.**—To review, there will be paroxysmal pain or an ache, intermittent lameness, tender spot, over the condyles, atrophy and rigidity, night cries, followed by uniform enlargement of the joint, which has a doughy feel.

**Differential Diagnosis** must be made from synovitis, acute ostitis, pyemic and pneumonic arthritis, arthritis deformans, Charcot's disease and rheumatism.

**Prognosis.**—The promise of perfect recovery depends upon the stage at which proper treatment is instituted, and the success one has in carrying out the treatment.

We have seen cases in the second stage get well with but slight deformity. We have seen cases do well in this stage until a second injury would hasten the onset of the third stage, resulting in excision or even amputation. Rarely we see cases, even in the first stage, go from bad to worse regardless of treatment. As a rule, however, a favorable termination may be

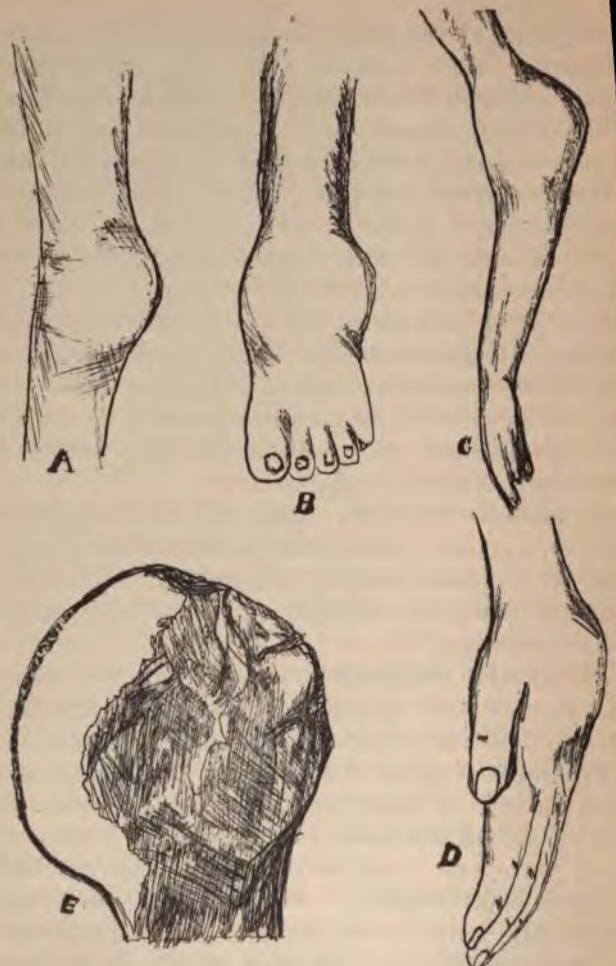



FIG. 29.

A. DISEASE OF KNEE-JOINT; B. OF TARSUS; C. OF ELBOW-JOINT; D. OF WRIST-JOINT; E. EPIPHYSIS OF HUMERUS.

expected in mild cases. In severe cases complete destruction of the joint occurs, and if resolution does take place, flexion and ankylosis will be the usual result.

Prolonged suppuration with mixed infection produces secondary involvement of the viscera, meninges, or other structures, hastening a fatal termination. Under proper and modern treatment many more cases get well, more limbs are saved by timely operations, and antisepsis, properly carried out, has reduced the death rate materially.

**Treatment** may be subdivided as follows: Conservative and operative. Conservatism is the course to be pursued, but this is only advisable when proper mechanical and constitutional treatment can be carried out.

As introductory to any variety of treatment, and for all stages, attention must be paid to the general health; specific medication, tonics, proper hygienic surroundings must be considered. Local applications of iodine, blisters, liniments, must be used during the early course. To promote absorption an ointment is an excellent remedy and the following is constantly used by the author:

℞ Menthol, gr. xx;
Vitogen, ℥i;
Glycerine, ℥i;
Creta Preparata, ℥i;
M. et fiat unguentum.

Sig. Apply as a paste over the entire joint and remove and renew every other day. Place one layer of gauze over the paste, and absorbant cotton over this. It is held in position with a bandage.

Under conservative treatment are included the various mechanical appliances to fix and protect the knee. Plaster-of-Paris is to be preferred. It perfectly immobilizes the joint, as well as protects it from injury. It should extend from the toes to well up on the thigh. One layer of cotton should be used under it. Absorbent cotton should never be used, as it absorbs the moisture from the plaster, and as it becomes wet its function of producing uniform elastic pressure is destroyed. The immobilizing appliance shown in chapter on synovitis and is generally the most satisfactory of the braces during the early stages.

It has been suggested, as a method of treating tuberculosis of the extremities, that an artificial congestion be secured by constricting the member above the disease, and thus retard the venous return, arguing that the bacillus of tuberculosis thrives in impoverished tissues, and dies in hyperemic structures.

Definite data as to the benefits of this method of treatment are wanting, and until it is further tested claims cannot be made for it.

**Interarticular injection** of a ten per cent. iodoform emulsion is of great benefit. If the accumulation in the joint is marked, it should be removed by aspiration before injection. Aspiration should be done as often as demanded, and it is a good practice to inject the emulsion afterward. The emulsion may be injected two or three times per week, and the amount should depend upon the destruction in the joint, generally from one or two drachms to an ounce or more.

CASE 5.—P. M., aged 11—After suffering for two years with tuberculosis of the knee, was found to have all symptons of this disease in the second stage. Pain, extreme sensitiveness, enlargement of the knee with thickening of the synovial sac,

throughout the entire area especially up under the quadriceps. Head of the tibia was dislocated backwards, and there was flexion of the leg to about 45 degrees. To overcome these deformities, a weight was applied to the foot and a second high up over the foot of the bed, the line of traction being against the subluxated head of the tibia. At the same time 10 per cent iodoform emulsion of alcohol and glycerine was injected under the patella, and in various places about the joint. This was supplemented with glycerine paste as per above directions.

In three weeks he left the hospital with the knee in plaster-of-Paris much improved in general health, and in local conditions. When the plaster was removed in two weeks the conditions had materially improved. There remained however, a very tender area under the tendon of the quadriceps above the patella. Iodoform emulsion was injected into the sensitive area, care being taken to deposit the solution in all parts showing evidence of active disease.

The tenderness from the injection lasted about 48 hours, but from this time on the patient suffered little and in two weeks there remained no tenderness in the joint. All the structures about the knee which had been so sensitive three months before had returned to a passive condition, and in three months of further treatment and immobilization the knee was placed in a convalescent brace, well. It is necessary to wear a convalescent brace for some months so that injury might not occur.

**Operative Treatment.**—After protection, traction, immobilization and injections have been tested, and the destruction of the joint continues, and the general condition of the patient is bad, some form of open operation is demanded. When there is found but little destruction of the epiphysis, a curettement of the granulations, or an arthrectomy will be sufficient. It will be necessary, if a sinus is found, that it be thoroughly curetted with a Volkmann spoon. When the articular cartilages and ligaments are disorganized, and the cancellous structure of the epiphysis is exposed, a resection will be necessary, which is done as follows:

Make a circular incision from one condyle to the other across the patellar tendon. The skin flap is dissected up above the patella, and section of the quadriceps tendon is made, thus entering the joint. As per Phelps, a circular cut is made through the condyles and tibia, the circle conforming to the curve of the condyles. The bones will dovetail together and prevent subluxation, and do not require wiring or nails.

FIG. 30.

Fig. 30 shows resection of knee joint for tuberculosis; representing the articular surfaces of the tibia and femur in a state of disorganization with erosion of the bone at several points. The patella was also diseased, and was removed. The case was primarily tuberculosis of the synovial membrane.

The bone near the cartilage was somewhat softened in several places but there were no cavities. To the right is shown the sawed surfaces of the same bones.

Excision was done by making circular cuts through the bones.

A typical operation is seldom made, and such an operation as may be demanded is done and the bones secured by wiring, nails, etc., as may be selected by the operator. In all of these operations, care must be taken to thoroughly curette or dissect out all surfaces of soft tissue or bone, and thus remove the source of further infection or extension of the disease. As a last resort amputation is necessary, the technique of which may be found in works of general surgery.

**Elastic Traction** may be used to advantage in tubercular synovitis. The brace shown in Fig. 31, as used by the author, makes effort to relieve interarticular pressure by an apparatus consisting of double bars, which are made to slide upon each other by the adjustments of elastics, which are thrown over hooks from the proximal ends of these bars. The distal ends are the fixed points.

FIG. 31.

For the knee the brace terminates above in a Thomas ring, and is fastened to the sole of the shoe below. In wrist and other joints not affording pressure points for traction, the distal ends are secured to the member by the use of adhesive plaster, which extends to the joints from both sides. As the elastics are thrown over the hooks, it brings them closer together, and throws

the fixed points farther apart, thus making traction upon the medium between the latter points.

Griffith quotes the records of the various methods of treating knee joint disease as follows :

| | TOTAL. | CURED. | DIED. | NO REPORT. |
|---|---|---|---|---|
| Amputations, | 280 | 157 | 83 | 40 |
| Excisions, | 1245 | 814 | 43 | 388 |
| Arthrectomies, | 137 | 77 | 9 | 51 |
| Fixation, | 55 | 46 | 4 | 5 |
| Injection, | 22 | 6 | 2 | 14 |
| Extension, | 19 | 12 | 3 | 4 |
| Expectant, | 33 | 9 | 17 | 7 |
| | 1791 | 1121 | 161 | 509 |

The following table gives an idea of the benefits of the various methods of treatment :

| | CURED %. | DIED %. | NO REPORT % |
|---|---|---|---|
| Amputation, | 56 | 20 | 14 |
| Excision, | 65 | 3 | 31 |
| Arthrectomy, | 56 | 6 | 37 |
| Fixation, | 83 | 7 | 8 |
| Injection, | 27 | 9 | 63 |
| Extension, | 63 | 16 | 21 |
| Expectant, | 27 | 51 | 21 |

## ANKLE AND TASRAL DISEASE.

**Ankle and Tasral Disease** occurs about as frequently as hip disease, and involves 14.4 per cent. of all tubercular bone and joint diseases.

The disease is primarily a synovitis in about 75 per cent. of all cases, the other cases beginning in the bones or ligaments. The most frequent cause, as in wrist disease, is sprains and other trauma, consequent upon the great exposure and constant use of this joint; the primary focus in the bone disease is most frequently in the os calcis and astragalus.

The pathology, symptoms, diagnosis, and prognosis are the same as in other joints.

When the joint becomes distended it is usually in front of the external malleolus first, later extending around the joint. (Fig. 29 *b*).

Pain is not a prominent symptom, although the joint may be tender to the touch. Statistics show that the mortality is increased by operation.

**Treatment** is rest and fixation, and in synovitis traction, counter-irritants, with a mixture of equal parts of tincture of iodine, tr. opii, fl. extr. belladonna, and glycerine, applied on sponge and held in position with oiled silk and bandage, will be of benefit in this as in all cases of acute joint disease.

Glycerine paste, as given on page 69, may be used.

## SHOULDER JOINT DISEASE.

This disease occurs less frequently than in any other major articulation, only 1.5 per cent, of all tubercular bone and joint diseases being of this joint.

The **causes** are the same as those producing changes in other joints.

The **pathology** differs from knee diseases in that the usual result in the latter is suppuration, or *caries necrotica*, while in shoulder disease there is seldom abscess formation. But one case of shoulder abscess has been seen by the writer, and it was associated with tubercular phthisis, and the patient eventually died. A large abscess of the arm was present, which required aspiration.

The **course** is very chronic, and there may be aching or slight pain in the shoulder for months, or indeed it may be for two or three years, before a diagnosis is made. These patients say the arm is painful and that they cannot lift it above the head, and they cannot lie on it at nights, and any effort at motion or use causes pain. A comfortable position cannot be found.

The disease occurs more frequently in adults. The primary focus, as a rule, is in the epiphysis of the humerus (Fig. 29, *e*), but it may be primarily a synovitis, or it may begin in the head of the scapula.

Atrophy of all the muscles of the shoulder is an early, constant and marked symptom. The arm is held closely to the side. The patient soon finds he is unable to put his hand to his head or reach behind

him to fasten his clothing, and has difficulty in putting on his coat.

**Abscess**, when it does occur, comes to the surface at points offering the least resistance, and this is found to be below the subscapularis, where it escapes under the deltoid and gravitates to near the insertion of this muscle. Old tubercular shoulders resemble dislocations, and Ridlon and Jones call attention to the fact that these conditions are frequently confounded. The resemblance is due to the atrophy of muscles, the possible absorption of a portion of the head of the humerus, and the position of the arm against the thorax.

In making a *diagnosis*, the foregoing symptoms and conditions must be studied well. Since they may date from trauma, it is easy to mistake it for an old dislocation, or fracture and dislocation, or injury of the biceps or other tendons. Rheumatism must be excluded by the presence of tumefaction, tenderness, and fever as early symptoms, and from its more acute course.

**Prognosis** is good under favorable surroundings, the tendency being to spontaneous recovery with ankylosis.

**Treatment** should be directed to the general health of the individual. Counter irritants may be used early. Inter-articular or peri-articular injections of iodoform emulsion should be used when it is thought that any point of the diseased surface can be reached with the needle, and are most useful in the synovial form. Rest must be given the joint, and this is best done by some fixation dressing as plaster-of-Paris, etc.

**Abscess** in shoulder disease should be treated as other tubercular accumulations. Local applications

of aristol and lanolin ointment should be made for induration or abscess formation.

In persistent cases it is best to open into the diseased area and curette, or even excise the head of the bone, or do such other operation as may be necessary.

**In Excisions** of the shoulder joint Senn has devised a new operation which he describes as follows :

"The external incision is made so as to form an oval cutaneous flap, which is turned upward, exposing the upper half of the deltoid muscle. It is commenced over the coracoid process, and is carried downward and outward in a gentle curve as far as the middle of the deltoid muscle, when it is continued in a similar curve upward and backward as far as the posterior border of the auxiliary space on the same level where it was commenced—that is, a point opposite the coracoid. The semilunar flap is next dissected up as far as the base of the acromion process and reflected. The acromion process is detached with a saw and turned downward, with the deltoid muscle attached. The capsule of the joint is now freely exposed. After the removal of all diseased tissue, or reducing dislocations, or such other operations as may be a necessary and proper preparation of the wound, the acromion process is replaced and held in position by two or three strong catgut sutures."

## ELBOW JOINT DISEASE.

**Elbow Joint Disease** is essentially a disease of young adults, the largest number occurring between the ages of twenty and twenty-five. It affects the sexes alike. It is slightly more frequent on the right than on the left side. In about 75 per cent. of cases it is primarily a bone disease. Six and three-tenths per cent. of all tubercular bone and joint diseases are of this joint.

**Symptoms** are limited motion, found early, with an inability to completely flex or extend the forearm. Swelling is found later about the bony prominences, and when it becomes extensive the joint assumes a spindle shape, which becomes marked as muscular atrophy increases. (Fig. 29, *c*). Abscess formation is more frequent than in shoulder cases, and not so frequent as in the knee.

The course, diagnosis, prognosis and treatment is about the same as in other joints.

Tonics, local absorbants and irritants, rest, fixation, subdermal injections, and the usual operations are to be used as demanded.

It is expected that rigidity be present in all cases of tubercular diseases of the synovial membrane, or of the epiphyses of the humerus, radius or ulna, but rigidity, while it may occur is not usually found in diseases of the shafts of these bones, but limited motion will be found.

CASE 6 illustrates this point. Male aged 20, injured elbow by falling from a bicycle. Had suffered for several weeks, and

had been given passive motion, but of course with exageration of symptoms. Upon examination, disease of the joint was excluded, but the lower end of the shaft of the femur was thought to be the location of the trouble.

Operation consisted in making a free incision down to the shaft on the external surface between the biceps and triceps. As a great surprise the bone was found denuded of periosteum for three inches of the length and four-fifths of its circumference. A shelf of new bone from one-eighth to one-sixteenth of an inch thick had formed around the shaft. With the hope that the nutrition to the centre of the bone was perfect, the new bone was removed from around the shaft, and the latter moderately curetted and the membrane allowed to drop down upon the bone in its original position with the hope that it would re-adhere and revitalize the shaft, which would positively have come away as a sequestra in a few months if left as found. The patient and friends were so informed. To the gratification of all the periosteum did adhere. The wound was well in a few weeks, the patient returned to work, and has remained well.

## WRIST JOINT DISEASE.

**Wrist Joint Disease** is most frequently a synovitis. Tubercular diseases of the carpus and contiguous structures comprise 6 per cent. of all tubercular joint diseases. It most frequently occurs in adult men, since they are more likely to receive injuries. It is generally a sequela of sprained wrist. The extensive synovial surface of the five separate cavities, and the delicate and complex structures of these joints, taken in consideration with the varied uses and exposures, make this joint more liable.

In synovitis the course is much the same as in other joints. In wrist disease, especially, is manual traction valuable as a means of diagnosis. Gonorrhea is a frequent cause of synovitis of the wrist joint. In tubercular ostitis of the bones of the wrist and hand we have a condition which will yield to early treatment, but the results are not gratifying. It has been said that in diseases of the carpus, or in tarsus diseases, these groups of bones must be considered as one bone. Rigidity and pain are present, and later the usual characteristic, doughy swelling over the dorsum of the carpus, will be found. (Fig 29 *d*). Abscess formation occurs in about half of all cases.

The **Treatment** consists in tonics, local irritants and absorbents, inter-articular injections, aspiration, elastic traction with fixation, and fixation of the joint with plaster-of-Paris and other splints, and such other capital operations as the case may demand. Care must be taken to remove all diseased tissue, as it frequently returns after operation.

Herman Mynter says longitudinal palmar incision is to be preferred when operation for extensive necrosis of the carpus is found necessary.

## SACRO-ILIAC DISEASE.

**Sacro-Iliac Disease,** also known as sacro-coxalgia, is a tubercular disease of the sacro-iliac synchondrosis. It is not common, and is most frequent between the ages of thirty and forty, rarely being found in children or advanced life.

**Causes** are trauma and exposure to cold.

**Pathological changes** are the same as those present in other tubercular bone and joint diseases. The primary lesion may be in the sacrum, ilium, or the interosseous fibro-cartilage. The tendency is to the formation of abscess, 60 per cent. of cases terminating in *caries necrotica.* The abscess may point upon the external surface of the pelvis, over the sacrum or internally, and discharge through the rectum. Sequestra are usually cast off, and may pass through the rectum.

**Symptoms.**- According to Young there are five cardinal symptoms, as follows:

"1. Pain, at first intermittent and located at the seat of the disease, which eventually becomes constant, when it may radiate through the pelvis and thigh, which is exaggerated by coughing, micturition, defecation, exercise, and by pressure against the ilii.

2. Lameness occurring early, pelvis tilted, body inclined toward the affected side, due to the patient's effort to get relief. Walking is difficult.

3. Elongation of the leg, which is only apparent and due to the tilting of the pelvis and resultant abduction of the thigh.

4. Swelling of the sacro-iliac joint.
5. Abscess."

To this Sayre adds a sixth, viz., local elevation of temperature.

Sacro-iliac disease pure and simple, or of the articulation, occurs in about fifty per cent. of cases. Tubercular disease is found in every part of the pelvis, sacrum and coccyx.

A recent case was disease of the spine of the ischium; another of the spinous process of the sacrum; another of the coccyx; another of the crest of the ilium, etc. In a recent hip excision the head of the femur had recovered, but the disease had extended to the acetabulum and the bones which form it, so that the periosteum was detached for one inch upward, forward and backward from the rim.

**Differential Diagnosis** must be made from lumbar and abdominal neuralgia, sciatica, lumbago, caries and necrosis of the ilium, lumbar Pott's disease, hip joint disease, osteomyelitis, osteosarcoma, enchondroma, gonorrheal rheumatism and arthritis deformans. *Sciatica* is generally found in old persons, and the pain is below and not above the gluteal muscles. In *lumbago* the tenderness is over the lumbar region and not over the sacro-iliac joint. *Lumbar Pott's* disease is generally found in children with spinal deformity. Absence of tenderness in sacro-iliac joint, and absence of apparent elongation and lameness, except when this disease is associated with psoas abscess, are differential points.

**Prognosis.**—In advanced cases it is very unfavorable, and fatal results usually occur from exhaustion, from suppuration and fever. Recoveries are more fre-

quent when proper treatment is carried out early. In abscess cases the mortality is 92 per cent., and in cases where abscess does not form the death rate is 6 per cent.

**Treatment** depends upon whether a diagnosis is made early or late, and whether it is one of siccus or necrotica. General health should be improved by tonics, generous diet, stimulants, etc. The joint should be immobilized by plaster-of-Paris, or a Thomas-polyclinic, as modified by the author, with the bar in front, and crutches should be used with a high sole on the well foot, allowing the diseased leg to swing pendant. Extension by weight and pully at night, or a traction brace to be worn constantly, is an important part of the treatment.

Local treatment should consist in counter-irritation with iodine, stimulating liniments, blisters and thermocautery.

The abscess should not be opened unless the case is attended with marked constitutional disturbances, when the walls of the sinuses should be curetted, sequestrae removed, and the wound packed with iodoform gauze. Operations should be performed in hospitals, or if without, strict antisepsis should be practiced, as there is great danger of secondary infection, which is one of the most frequent causes of death.

Old sinuses should be injected with hydrogen dioxide, for a few days, followed by the use of iodoform emulsion, or balsam of Peru, and if persistent, they should be curetted under an anesthetic, or as advised by Dr. Buchanan excision of the sacro-iliac joint should be made.

## HIP-JOINT DISEASE.

**Hip-joint** disease is also known as morbus coxarius, coxalgia, and coxo-tuberculosis. It is a tubercular disease of the hip-joint, and embraces about 16 per cent of all tubercular bone and joint diseases. The primary focus is generally found in the head of the femur, although it may be in the neck, greater trochanter, acetabulum, ligamentum teres, or capsular ligament. It may also be, and is in about 7 per cent of cases, primarily a synovitis. In children ostitis is more frequent, and in adults the primary lesion is more frequently in the synovial membrane. It is generally single, although a secondary focus may appear on the opposite side, and Ridlon has reported fourteen cases of double hip disease. Statistics show that about two-thirds of cases are in the left hip.

**Etiology.** *Age.* It is distinctively a disease of childhood, the majority of cases occurring between the ages of 2 and 13; although cases of true hip disease have also appeared in patients over sixty years of age. Eighty-four per cent of cases occur before the age of 14 years. Relapses occur more frequently from 30 to 40 years of age.

*Sex.* Males are more frequently the victims of hip disease because they are more active and more liable to receive injuries. L. A. Sayre says that phimosis is a cause, and Barwell says that it is present in 95 per cent of cases. The admission that genital irritation may produce reflex symptoms, resembling hip-joint disease,

would also account for the greater number of males than females.

*Heredity* plays a most important part in the production of the disease. Indeed, it may be said that it is rare that an hereditary history cannot be traced. Gibney, in something over five hundred cases of tubercular disease, has found but one without an hereditary history. Senn has called attention to the fact that the more severe tubercular diseases affecting bones and joints are the result of slight injuries. In other words, it would be better for one of these tubercular children to receive a fracture than a slight contusion, although slight injuries are harmless in children enjoying perfect health.

**Symptoms.** The symptoms of early hip disease are the most obscure of all joint affections, but in the later course they are so manifest that no one need mistake this disease for other affections. As a rule the symptoms develope gradually, but in some cases the onset is very sudden.

*Limping* is an early symptom. It is more marked in the morning and passes off as exercise is taken. It is always present, as one of the early as well as the later symptoms.

*Atrophy.* The reflex spasm of all muscles which have to do with the movements of the affected joint soon results in atrophy and this symptom may be found as early as one week after the onset of the disease, and even before many of the other symptoms have been observed. This can be detected by circumferencial measurement of the thighs, and can be seen by the disappearance of the gluteal fold and dimple and flattening of the buttock. In females, the vulva is

lower on the affected than on the other side. The atrophy which is such a marked symptom in all cases of hip disease is much more marked after excision, and Vincent has shown that the foot is much smaller after this operation, the fact being demonstrated by taking a series of plantar imprints. He found atrophy of all the structures of the foot, and especially of the os calcis.

*Night Cries* may be a very early symptom. They are heard during the early part of the night. As the patient goes to sleep the muscles which have been in spasm during the wakeful moments relax. This results in a change of relationship in the joint, which causes pain and the sudden reflex contraction of the muscles produces the characteristic cry.

*Pain.* The pain of hip disease is not usually in the joint, but is referred to the knee and the leg as low as the ankle. The pain is reflex and due to the irritation in the joint, associated with spasm of the muscles crossing the joint in their effort to protect the diseased area. A joint in tuberculosis is more or less sensitive, and the vibratory impulses imparted to it by walking, and in acute cases even jostling of the bed increases the pain, and the rigidity of the muscles is an effort on the part of nature to afford protection. Pain is often remittent; it may, indeed, be absent, and is not at any stage of the disease a diagnostic sign for or against the presence of hip disease. When pain is referred to the knee it means that the primary focus is in the femur, and when the pain is in the neighborhood of the joint or sacrum there is more likely to be synovial or pelvic disease.

*Glandular* enlargement may be found early and is a forerunner of abscess formation. A doughy or brawny

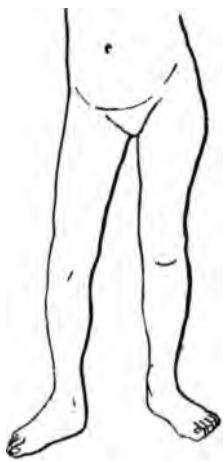


FIG. 32.
FIRST STAGE.

FIG. 33.
SHOWING FLEXION FROM SIDE.

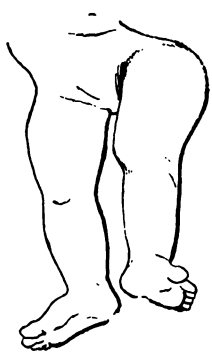


FIG. 34.
SECOND STAGE.

FIG. 35.
THIRD STAGE.

feel about the joint, as Steele calls it, is imparted to the touch.

**Deformity.** A tilting of the pelvis is observed quite early, due to a fixed condition of the thigh upon the pelvis. The abnormal and fixed relationship between the pelvis and thigh found in the early stage results in a condition of apparent lengthening, during which time the leg is in abduction and slight flexion, (Fig. 32.) Later, or during the stage of apparent shortening, the leg is thrown in toward the median line in a position of adduction, with flexion (Fig. 34) This change of relationship is due to the escape of the product of tuberculosis from the bone into the joint bag, and from the joint bag into the surrounding tissues. When the leg is in abduction the foot is also in this position, and the toe is generally everted; (Fig. 35) when in adduction the toe is generally inverted.

There is a vast difference between the *stiffness* or rigidity of a joint, and *limited motion.* The former term means restricted motion in all directions, and in the latter, motion is limited in but one direction, the joint being freely movable in all other directions.

**Shortening.** In the study of this deformity we estimate it as real, when actual bone shortening exists, and is determined by measurement from the anterior superior spine to the internal malleolus, and apparent when it is due to flexion and adduction of the thigh upon the pelvis. The constant spasmodic condition of the muscles makes such pressure of the diseased head of the femur against the superior rim of the acetabulum as results eventually in a wearing away of the head of the bone as well as a portion of the rim of the acetabulum. When there is marked, or it may be complete,

destruction of the head of the femur there may result a partial or complete dislocation. The method of estimating the amount of shortening is done by measuring the distance from the anterior superior spine to the internal malleolus of the well side first, and comparing it with the distance from the same points on the affected side. A record of this should be kept at every examination so as to determine whether the shortening is increasing or not. The amount of shortening may also be determined by a study of Nelaton's line, which is a line drawn from the anterior superior spine to the tuberosity of the ischium; if the head of the bone is in the normal acetabulum, the line will cross the highest point of the great trachanter.

The shortening after excision is 1 to 4 inches; after no treatment, 1 to 6 inches, and after correct treatment from 0 to 1½ inch.

To estimate the amount of *abduction* and *adduction*, use is generally made of the goniometer; but this method is rather indefinite and the instrument is not always at hand.

To make the estimate, move the limb slowly in the direction of abduction and adduction, alternately, and observe the movements of the iliac spines and allow the leg to rest when they are at right angle with the axis of the trunk. One arm of the goniometer is then held parallel with the line of the iliac spines. The other arm is then made to coincide with the line parallel, as near as may be, with the axis of the limb, which may, for this purpose, be considered to extend from the middle of Poupart's ligament to the middle of the heel. The degree of abduction or adduction is shown by the indicator on the goniometer.

Lovett has given us a table for estimating these deformities, which may be presented as follows: "In measuring patients it is found that real and practical (apparent) shortening of the leg are often not the same in the same patient, and that the difference between them varies in proportion to the amount of deformity present. This was taken as a basis for constructing the following working table. To measure by this method the patient is made to lie straight with the legs parallel. Real shortening is measured with the ordinary tape measure from each anterior superior spine to the corresponding internal malleolus, and that practical shortening or apparent shortening, is found by measuring from the umbilicus to the internal maleoli. The difference between these two kinds of shortening is seen at a glance. The only additional measure necessary is the distance between the anterior superior spines which is taken with the tape. Turning now to the table, if the line which represents the amount of difference in inches between the real and apparent shortening is followed until it intersects the line which represents the pelvic breadth, the angle of deformity will be found in degrees where they meet. If the practical shortening is greater than the real shortening, the diseased leg is abducted. If less than real shortening, it is adducted.

Lovett gives the following example: length from anterior superior spine of right leg, 23; left leg, 22½; length from umbilicus of right leg, 25; left leg, 23; the difference between the former representing real shortening is ½ inch and the latter, or apparent shortening, is 2 inches, and the difference between the real and the apparent is 1½ inches; the pelvic measurement from spine to spine is 7 inches. By referring to the follow-

ing table the line from 1½ inch and from 7 will intersect at 12, which shows that there are 12 degrees of adduction of the left leg.

LOVETT'S TABLE.

DISTANCE BETWEEN ANT. SUP. SPINES IN INCHES.

| DIFFERENCE IN INCHES BETWEEN REAL AND APPARENT SHORTENING. | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ | 7 | 7½ | 8 | 8½ | 9 | 9½ | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ¼ | 5° | 4° | 4 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 |
| ½ | 10 | 8 | 7 | 6 | 5 | 5 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 2 |
| ¾ | 14 | 12 | 11 | 10 | 8 | 8 | 7 | 7 | 6 | 6 | 5 | 5 | 5 | 4 | 4 | 4 | 3 | 3 |
| 1 | 19 | 17 | 14 | 13 | 11 | 10 | 9 | 9 | 8 | 7 | 7 | 7 | 6 | 6 | 6 | 5 | 5 | 4 |
| 1¼ | 25 | 21 | 18 | 16 | 14 | 13 | 12 | 11 | 10 | 9 | 9 | 8 | 8 | 7 | 7 | 7 | 6 | 6 |
| 1½ | 30 | 25 | 22 | 19 | 17 | 15 | 14 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 9 | 8 | 7 | 7 |
| 1¾ | 36 | 30 | 26 | 23 | 20 | 18 | 17 | 15 | 14 | 13 | 13 | 12 | 11 | 10 | 10 | 9 | 8 | 8 |
| 2 | 42 | 35 | 30 | 26 | 23 | 21 | 19 | 18 | 16 | 15 | 14 | 14 | 13 | 12 | 12 | 10 | 10 | 9 |
| 2¼ | | 40 | 34 | 30 | 26 | 24 | 21 | 20 | 19 | 17 | 16 | 15 | 14 | 14 | 13 | 12 | 11 | 10 |
| 2½ | | | 39 | 34 | 29 | 27 | 24 | 22 | 21 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 |
| 2¾ | | | | 38 | 32 | 29 | 27 | 25 | 23 | 21 | 20 | 19 | 18 | 17 | 16 | 14 | 13 | 12 |
| 3 | | | | 42 | 35 | 32 | 29 | 27 | 25 | 23 | 22 | 21 | 19 | 18 | 18 | 16 | 14 | 13 |
| 3¼ | | | | | 39 | 36 | 32 | 30 | 27 | 26 | 25 | 22 | 21 | 20 | 19 | 17 | 15 | 14 |
| 3½ | | | | | | 40 | 35 | 33 | 30 | 28 | 26 | 24 | 23 | 22 | 21 | 19 | 17 | 16 |
| 3¾ | | | | | | | 38 | 35 | 32 | 30 | 28 | 26 | 25 | 23 | 22 | 21 | 18 | 17 |
| 4 | | | | | | | 42 | 38 | 35 | 32 | 30 | 28 | 26 | 25 | 23 | 21 | 19 | 19 |

Judson, in his recent paper on "Methods of Measuring Deformity of Hip Disease," furnished us with very satisfactory methods for measuring abduction, adduction and flexion, and uses as a basis for his deductions the diagrams of Mr. Howard Marsh.

**Flexion** is measured by placing the patient on his back on a table, and elevating the diseased leg to a point where the lumbar spine rests upon the table. The goniometer is now held with the axis of the arms over the axis of the hip joint. One arm is held horizontal while the other one is made to coincide with a line drawn from the greater trochanter to the centre of the knee joint and the degree of flexion will be shown by the indicator on the goniometer.

Flexion is also estimated by the following method, as laid down by Kingsley: The patient lies down upon a table flat on his back, and the surgeon flexes the diseased leg, raising it by the foot until the lumbar vertebrae touch the table, showing that the pelvis is in the correct position. With the leg in this position, a tape measure is held along the outside of the leg, from the point where this line would touch the table. Two feet from the table is measured off and marked on the leg, and from this point the distance is measured to the table perpendicularly, (Fig. 36). The length of this perpendicular line is recorded. The following table shows the degree of flexion opposite the figures in inches.

KINGSLEY'S TABLE.

| IN. | DEG. | IN. | DEG. | IN. | DEG. | IN. | DEG. |
|---|---|---|---|---|---|---|---|
| 0.5 | 1 | 6.5 | 16 | 12.5 | 31 | 18.5 | 50 |
| 1. | 2 | 7. | 17 | 13. | 33 | 19. | 52 |
| 1.5 | 3 | 7.5 | 19 | 13.5 | 34 | 19.5 | 54 |
| 2. | 4 | 8. | 20 | 14. | 36 | 20. | 56 |
| 2.5 | 6 | 8.5 | 21 | 14.5 | 37 | 20.5 | 58 |
| 3. | 7 | 9. | 22 | 15. | 39 | 21. | 60 |
| 3.5 | 9 | 9.5 | 24 | 15.5 | 40 | 21.5 | 63 |
| 4. | 10 | 10. | 25 | 16. | 42 | 22. | 67 |
| 4.5 | 11 | 10.5 | 27 | 16.5 | 43 | 22.5 | 70 |
| 5. | 12 | 11. | 28 | 17. | 45 | 23. | 75 |
| 5.5 | 14 | 11.5 | 29 | 17.5 | 47 | 23.5 | 80 |
| 6. | 15 | 12. | 30 | 18. | 48 | 24. | 90 |

The accompanying illustration also shows the method of estimating flexion.

FIG. 36.

**Examination.** In making an examination the patient should be stripped and an inspection made while he is standing and walking, and his attitude studied. The patient should be asked to pick an object from the floor, when, if hip disease is present, the spine and knee will be flexed but the hip will remain rigid. Lay the patient down on a table and freely move the well leg, following this by gentle manipulation of the suspected extremity. Never use an anesthetic in making a diagnosis, for severe manipulation of a tubercular joint does great damage, and, to my notion, is as heroic as an exploratory incision in suspected abdominal disease, and does far more damage. The so-called "grating" is seldom found. Thomas' test is quite diagnostic: It consists in placing the patient on his back, and flexing the well leg sufficiently to allow the forearm on the same side to pass under the knee, (Fig. 37). If the suspected leg can be completely extended so as to touch the table at the knee joint, hip joint disease can be excluded. When hip joint disease is present, the

knee will stand up in a flexed position some distance from the table, or when the knees are forced down on the table the spine will be elevated, or in a condition of lordosis, (Fig 38). In moving about, in a sitting or

FIG. 37.—THOMAS' TEST.

FIG. 38.—LORDOSIS OF HIP DISEASE.

FIG. 39.

TEST FOR PSOAS' CONTRACTION.

reclining position, the patient carries the diseased member upon the well one, and when lying still, natural traction is practiced by the patient pressing the toes of the well foot upon the dorsum of the other.

**Pathology.** The changes which occur in hip disease do not differ from those found elsewhere, except that due to the difference in the shape of the joint. The primary focus is usually in the head of the femur, but it may be in the neck or trochanter, or any part of the pelvis. It rarely begins as a synovitis, and when the joint does become involved it is because the primary focus has extended into the joint. Fig. 40 shows the

FIG. 40.—TUBERCULAR FOCUS, (AFTER KRAUSE).

usual location of the primary focus. Fig. 41 shows a hip joint in advanced stage of destruction, which was excised by the author. The shaft of the femur as may be seen was denuded, and required the removal of a

second piece. Fig. 42 shows the same case some weeks after the operation. The brace shown is so constructed as to prevent shortening while the process of repair is going on. As the periosteum was preserved as much as possible during the operation there was sufficient reproduction of bone to sustain the weight of the body.

FIG. 41.

It is not uncommon to have repairs take place to a surprising degree when care is taken to preserve the periosteum, as is illustrated by the following case.

CASE 7—Boy aged 9, had been suffering with hip disease for two years. Surgeon incised a large abscess over the outer aspect of the thigh, thinking he would find disease of the shaft of this bone, but it was not found. He opened the abscess

FIG. 42.

again, but did not find the diseased bone. The sinus following the second operation did not close ; an abscess formed back of the trochanter several months later, and it was incised. This also remained open, until the writer saw the case. A probe could be

passed for several inches along both these sinuses, toward the apex of the trochanter, but dead bone could not be located. It was decided to excise, and a slightly modified Langanbeck incision was made, and the fibres of the glutei muscles separated, and the joint capsule entered, the head of the bone showed evidences of old tuberculosis, and superior portion was somewhat eroded, and this was curetted. The pelvis was the principle area of disease. The rim of the acetabulum was denuded, and the ilium was bare for an inch from the rim forward, upward and backward, but the bone had not exfoliated, neither was it rough at any point, but it was as firm as bone could be, but completely stripped. As we have seen areas of shafts of bones and skull stripped of its periosteum recover, it was decided to moderately curette the exposed surface, and remove new bone as it appeared as a scale at several points, and give the periosteum an opportunity to re-adhere. Old sinuses were curetted and packed, but the cavity between the periosteum and ilium was not packed, but was permitted to cling to the bone. In two months the sinuses all closed, and the wound was entirely well.

**Diagnosis.** A diagnosis may be made from a summary of the foregoing symptoms which may be tabulated as follows: 1st. Muscular fixation. 2nd. Lameness. 3rd. Attitude and shortening. 4th. Atrophy. 5th. Pain. 6th. Swelling.

**Differential diagnosis** must be made from lumbar Pott's disease, in which there will be found rigidity of the spine; infantile spinal paralysis, and spastic paralysis, in which conditions the history of the case must be considered; sacro-iliac disease, disease of the knee, hysterical affections, rheumatism, coxa vera and congenital dislocation of the hip. Abdominal abscess and diseases which press upon the psoas and iliacus muscles also cause limited motion of the joint and may confuse one. Pott's abscess, as it gravitates to the region of the joint along the psoas muscle, causes

flexion, adduction and limited motion of the hip joint, but not rigidity, and a mistake in diagnosis is easily made. Spastic paralysis produces rigidity of the hip but not absolute stiffness, and continuous pressure will change the relationship of the thigh to the pelvis in a few minutes, a thing not possible in hip joint disease. The joint in congenital dislocation is flail-like rather than rigid. Possibly hip joint disease is most frequently taken for knee disease, on account of the fact that pain in hip disease is referred to this joint.

In tubercular disease of the pelvis or when the disease is primarily of the acetabulum instead of the head of the femur, a very important differential point is found in the location of the thickening of the soft tissue. If the thickening is on a line with the acetabulum and in a measure destroying the outline of this bone, the primary focus will generally be found in the femur but when the thickening is above and around the rim of the acetabulum pelvic disease will generally be found.

Two cases of hip disease have been examined recently, which present points of unusual interest.

CASE 8—Aged over 20, has been disabled for about twenty eight months. At the time of first examination, there was an abscess on the outside of the thigh to almost the diameter of the thigh, but it was running a harmless course. The general health was good. There was no deformity as adduction, abduction, flexion or shortening. There was no rigidity; the thigh being freely movable in every direction. There was no tilting of the pelvis. The movements of the thigh were to a right angle. A peculiar feature of the case was that while lying down the thigh when flexed to a perpendicular could not be extended until the patient would rise, or the thigh apparently locked at a right angle, and could not be unlocked while the patient was in recumbency. The disease is doubtless pelvic or at least not in the joint.

CASE 9—Aged about 18, had been suffering with pain on backpart and outside of thigh, outside of knee, and ankle for about 18 months. There was no deformity except a slight limp. The joint was freely movable except when the glutei muscles were put on tension. The capsule appeared healthy. There was no tenderness except above and back of the greater trochanter. Diagnosis of tubercular disease of the ilium back of the acetabulum was made.

**Prognosis.** Hip joint disease is self limited, and spontaneous recovery with bone deformity is generally the result. The earlier the patient is put upon treatment the more rapid the course is run and the less the deformity, and *vice versa*. After recovery the patient enjoys excellent health throughout life with only the hindrance caused by the resultant permanent deformity.

Cases are under treatment from one to four, and in rare instances, six years, and without treatment or poor treatment from three to ten years.

**Mortality.** The death rate in non-suppurating cases, in which proper treatment is instituted early, is about 2 per cent; in suppurating cases, with proper treatment, about 5 per cent, and in neglected cases with suppuration about 34 per cent.

**Cause of Death.** Death may be caused by secondary foci in the lungs, meninges and other parts of the body, from amyloid degeneration of the viscera, from exhaustion, from suppuration and mixed infection, and from intercurrent disease. The cause of death in suppurating hip disease in the Alexandria hospital is given as follows: albuminuria and dropsy, 20.8 per cent.; meningitis, 16.7 per cent.; exhaustion, 9.4 per cent.; after operation, 9.4 per cent.; intercurrent disease, 7.3 per cent.; phthisis, 4.2 per cent.; phthisis and

albuminuria, 3.1 per cent.; erysipelas and pyemia, 3.1 per cent.; unknown, 25 per cent.

**Results in hip disease.** Lorenz advises the encouragement of ankylosis of the hip in a good position, by fixation with a plaster-of-Paris spica, stating that it is as good as can be expected. He discards as useless the traction braces used in this country, and Albert and Bilroth agree with him. Sayre says that this clearly shows that they do not understand the employment of these various forms of apparatus. Burns considers 600 cases. He says the death rate is 40 per cent and that perfect recovery never occurs. As a contrast to this, one of the pioneer orthopedic surgeons of this country, Lewis A. Sayre, reports 407 cases of hip joint disease treated between 1859 and 1889, not including the cases which required excision; 118 were in the first stage, 119 in the second stage, 82 in the third stage, and in 88 the stages were not given. The results in these cases were as follows: 301 were cured, in which 71 recovered with perfect motion, 142 with good motion, 83 with limited motion, 5 with ankylosis. The rest of these cases having left, been discharged, were under treatment, abandoned treatment, or the results were unknown. Nine deaths occurred, as follows: from exhaustion two, tubercular meningitis five, phthisis one, pneumonia one. In none of these cases was immobilization used, but instead the long Sayre was used in 88 cases and the short Sayre in 192 cases of those in which the results were known.

**Treatment** is divided into conservative and operative. Conservative treatment is subdivided into hygienic, medical and mechanical. Hygienic measures are important, for it will be found that these cases are reduced

in vitality and frequently have poor appetites. Outdoor exercise for patients who are able to be out is essential, and when the recumbent treatment is being carried out a pneumatic tired carriage should be secured and an afternoon airing given the patient when the weather permits. Pine mountain regions are especially beneficial to cases with tubercular bone diseases. An afternoon nap should be insisted upon. Generous diet, consisting of milk, meat juice, and fruit, is most essential, and tonics, reconstructives and specific medication should be used. Compound syrup of hypophosphites is undoubtedly one of the best reconstructives for these little patients. If a history of inherited syphilis is obtainable, or even suspected, syrup of the iodide of iron, or syrup trifolium compound should be given for months. I have seen cases with such an history and suffering with marked hip joint disease, get well in half the time required for treatment by mechanical means alone.

CASE 10—The following case is introduced to illustrate this fact: J., aged 6, showing characteristic limp, limitation of motion, night cries, slight flexion, adduction and marked inversion of the foot without fever or constitutional disturbances. A hip brace as used by the author, was ordered and adjusted and worn for six months when the symptoms had so much improved that the short brace as used by Sayre (Fig. 47) substituted. This brace was worn for another six months, when it was removed and the patient discharged. All symptoms had disappeared except a slight limp, due to the restriction to locomotion resulting from the continued use of the brace, which disappeared in a couple of months when the patient walked without a limp. There was reason to believe that the child had inherited a specific taint, and she was given, very faithfully, syrup trifolium compound throughout the entire course of treatment, and to this must be attributed in part the prompt recovery.

The prime object of all treatment is to alleviate symptoms, shorten the course, and prevent deformity. *Mechanical* treatment not only prevents deformity, and reduces the length of time these cases are under observation, but it also reduces the mortality. It is claimed, and very correctly too, that vigorous mechanical treatment, carried out on correct lines, prevents abscess formation. Statistics show that with abscess, the death rate is 34 per cent, and without 7 per cent. When these facts are considered, proper mechanical treatment becomes of the greatest importance.

Mechanical treatment may be considered under the following subdivisions : (*a*) recumbency, with fixation, or the English method ; (*b*) traction, or the American method ; and (*c*) a combination of the two, or fixation and traction. As these patients place the toe of their well foot upon the dorsum of the foot of the affected side to relieve pain by traction, they give a forcible hint that traction, to overcome the spasmodic contraction of the muscles about the joint, and thus relieve interarticular pressure, is the first principle of mechanical treatment. Next to traction, by way of suggestion made by the patient, they demand protection. In recumbency, the principles of treatment, viz., traction, protection, and immobilization, are carried out by the use of the wire cuirass of Bauer, a stretcher bed, a plaster-of-Paris spica, with a weight and pulley extension as first described by Gurdon Buck. During the early stage, or during the more acute inflammatory changes, the bed treatment is preferable in that it offers complete rest to the hypersensitive joint. *Night cries* and other symptoms are magnified without treatment, or when

proper treatment is not applied, and improve under treatment. In some cases, when mechanical treatment is properly applied the various stages of the disease come and go in comparative comfort, and recovery takes place with little or no shortening, and practically a perfect joint.

As soon as muscular spasm yields to treatment and the patient becomes more comfortable, ambulatory treatment must take the place of the bed treatment. When confined to bed the vital forces begin to degenerate, and exercise must be given to the patient in order that reconstruction may take place in the diseased area, rather than degeneration and further extension of the disease.

Fixation is best carried out by the use of the Thomas hip splint, which is more easily applied than plaster-of-Paris, more economical than the leather splint of Vance, the metal brace of Willard or Blanchard. Traction alone is best carried out by the polyclinic splint and its numerous predecessors, known as the Davis, the Sayre, the Taylor, the Andrews and the Judson braces.

Mechanical treatment of to-day, as would then appear, is fixation and traction. Up to the time of the introduction of the Phelps no brace combined these two indications in one ambulatory splint. Since that time Bradford and Lovett have so modified the Thomas as to make it a walking crutch, and also afford traction and fixation. The Phelps affords traction, fixation, and protection, but these are principles in the brace which cannot be altered. In order that fixation may be used with traction when, and as long as desired, and discarded at will, without in any way interferring with the traction, the splint shown in Fig. 43 was devised.

FIG. 43.

FIG. 44.

FIG. 46.

FIG. 45.

FIG. 47.

THE AUTHORS HIP BRACE.

Fig. 44 shows a polyclinic brace, which is had by removing two screws and lifting off the Thomas' posterior bar, Fig. 45. Fig. 47 shows a short Sayre, the part of the brace given us after the removal of the lower end of the walking crutch, Fig. 46. This is comparatively an inexpensive brace. It is applied as are the braces of which the one described is a combination.

Fig. 48.

Fig. 49.

A THOMAS' HIP BRACE.

A Thomas Brace is shown in Fig. 48, and in Fig. 49, the same is shown as applied to the patient. The most notable advocate of the treatment of hip disease by this method is Dr. Ridlon of Chicago. If traction in the treatment of hip disease is desirable, then the Thomas

FIG. 50.—THE AUTHOR'S HIP BRACE APPLIED.

brace does not meet the requirements. It must be confessed that traction at certain periods of the disease accomplishes little, and at this time a Thomas meets the indications. The trouble of making discrimination and of exchanging braces may be avoided by using a brace which immobilizes and makes traction at the same time as is possible with the author's brace. Fig. 51 shows a short Sayre, which has proven very satisfactory in the hands of the inventor. A long Sayre is practically the same as shown in 51, with an extension below the foot, and differs but slightly from Fig. 44.

FIG. 51.

A SHORT SAYRE HIP BRACE.

In using the various long hip braces traction is made from the lower horizontal portion, and counter traction from the perineal straps from the pelvic band. Traction is applied to the leg by the use of two strips of

moleskin plaster which extend from near the hip to the shoetop, one on the inner and one on the outer side, to the lower ends of which a buckle is attached. They are held to the leg by a roller bandage. A stocking is put over this through which holes are cut above the shoetop, and immediately over the buckles large enough to allow them to drop out. Leather straps which are riveted to the bottom of the brace are now fastened in the buckles.

The straps may be made of a very firm quality of elastic webbing, to carry out the idea of elastic traction in the treatment of these hip cases upon the same principle as has been recommended by the author, in the treatment of all forms of joint disease, when muscular spasm is a cause of interarticular pressure and resultant pain.

All traction hip braces should extend far enough below the foot to allow the leg to swing pendant, and the foot to remain high enough to prevent the patient from bearing weight upon it. A cork sole (Fig. 52) should be worn on the well foot, thick enough to bring it on a line with the lower end of the brace, and in taking measurements for a brace this fact should be considered.

About 50 per cent of cases do not use crutches. It is no doubt better to use them in all cases, but if the patient learns to walk well without them, and at the same time sufficient traction is maintained to relieve pain, and prevent shortening, he should be allowed to do so.

Drs. Bradford and Lovett in a paper published in the *New York Medical Journal* on "Distraction in the Treatment on Hip Disease," describe a series of experiments to determine the amount of distraction possible under

four different condition: 1st, on the cadavera of healthy hips; in which twenty pounds produced a separation of one-eighth of an inch; 2nd, on the cadavera of diseased hips, in which twenty pounds produced a separation of a little more than one-half inch; 3rd, on healthy individuals, in which twenty pounds

FIG. 52.

CORK SOLE FOR WELL FOOT DURING TREATMENT.

produced a lengthening of a quarter of an inch; 4th, on patients suffering from hip disease, in which five-eighths of separation occurred in one case."

*Deformity.* Dr. Judson suggests, as a method of reducing or preventing shortening in hip joint disease, of instructing the patient to practice systematic walking by dividing the time of the step between the two feet equally. This is done by having the patient count time while walking or dancing, with daily lessons at home by the parents and frequent and persistent effort on the part of the surgeon to see that the child observes

the uniform length of step and uniform gait. This is advised for functional or apparent shortening. He was able to reduce 30 degrees of flexion in seven months in one case, in another from 60 to 20 degrees in four months. Adduction was reduced from 40 degrees to 5 degrees in seven months. In structural shortening not so much improvement can be expected.

If deformity cannot be overcome, as suggested by Judson, the patient should be put in bed and traction made by Buck's extension. The weight is secured to the leg by adhesives, on the inside and outside, extending well up to the hip. The pulley should at first be high enough above the foot of the bed to place it on a line with the deformity and gradually lowered as flexion, adduction, and shortening are overcome. The weight should be as much as can be borne by the patient without discomfort. When the leg is placed in a normal position, if this is possible, or as near as may be, it should be held there for some time by an anterior retaining wire frame extending from the knee to the nipple.

When ankylosis is complete, and deformity so marked that it is desirable to correct it, this may be done by a Gant operation, which consists in subcutaneous osteotomy of the femur just below the trochanter. It may be necessary to make section of the tensor vaginæ femoris, sartorius or other structures preventing complete extension of the femur.

In Fig. 53 is shown a case of marked deformity following bad treatment. In Fig. 54 may be seen a similar case after correction by a Gant osteotomy. In this case the flexion, adduction and shortening were about as shown in Fig. 53 and the operation not only

corrected the angular deformity but increased the length of the leg to about that of the other.

It is not an easy matter to get one of these patients out of bed when he has been confined for months. For this purpose the padded board as shown in Fig. 55 will

FIG. 53.

FIG. 54.

be quite satisfactory. As may be seen it is a board longer and wider than the patient. It is sawed through between the legs to the perineum, at which point the side under the well leg is cut off. This piece is again cut under the knee, which makes three pieces A, B and C. The upper part, B, is hinged to its original position so as to turn up, and the lower segment, C, is hinged so as to turn down as shown. B is now secured to the corner of a table or stool by screws so as to allow the

part upon which is resting the affected leg, and section C, to swing free. This leaves the entire board, except section B, entirely free. With the patient on this the head is slightly elevated as may be tolerated by the patient, and the elevation is gradually increased up to the perpendicular during the course of a few weeks. The inclination may be regulated and secured by a long hook made of heavy wire, as shown, on the side of the well foot, D.

The *management of the abscess* of hip-joint disease is still under discussion. The general surgeon incises all abscesses, and has as his first principle of treatment the

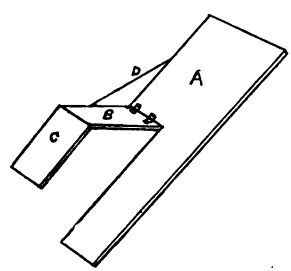



FIG. 55.

removal of a tubercular focus no matter where found. On the other hand, the mechanical surgeon, or orthopede, practices conservatism, never opens an abscess, and does not even aspirate. Between these two extremes the orthopedic surgeon's aim is to adopt a course of treatment which allows him to incise and curette when necessary, and to abstain when cases are running a harmless course.

The injection of abscesses after aspiration, with a ten per cent. solution of iodoform and glycerine, as

advised by Senn, is good treatment. It is claimed for this treatment that it not only relieves pain, but the iodoform destroys the bacilli.

What may be given as indications for incision of these abscesses are: when they are enlarging rapidly, are associated with great pain, are burrowing and producing pressure upon other important structures, or are attended with marked sepsis.

When an abscess appears on the surface as a tumefaction, merely, with no other evidence that it is an abscess than that it is associated with hip-joint disease, to incise and subject the patient to further danger of mixed infection, would be anything but good treatment.

Vance reports a case of rupture of the femoral artery, caused by pressure from extension of hip abscess. The artery was ligated resulting in gangrene. He amputated at the hip and the case recovered.

Gibney analyses ninety cases of hip joint abscess as follows:

| | | | |
|---|---|---|---|
| Abscesses opening spontaneously | 18, | with 13 | good results. |
| Abscesses aspirated | 43, | " 4 | " " |
| Abscesses incised | 49, | " 31 | " " |
| Cases excised | 31, | " 27 | " " |

Aspiration and injection of tubercular joint, when a doughy condition is found associated with pain or sensitiveness, is of undoubted value. The injection of iodoform emulsion alone, or the puncture affords relief, as the following case shows:

CASE 11—Mabel D., aged six years. Family history good. Fourteen months before, she had a fall from a step, and shortly afterwards a limp was observed, followed by night cries, destruction of gluteal fold and dimple; some flexion and abduction. A hip splint, such as has been described, was worn continuously.

An abscess developed and was aspirated and injected. When fulness first developed about the joint, aspiration was attempted, but no pus was found. The injection of iodoform was resorted to, and after the first one the pain was relieved and never returned in its original severity. Later aspirations revealed the product of tuberculosis, but after a number of aspirations and injections, the morbid material ceased to re-accumulate.

Otto Von Bunger says that in making injections into this joint the needle should be introduced at the inner

FIG. 56.

PATTERN TO BE USED FOR PERMANENT SHORTENING AFTER RECOVERY.

border of the sartorius, and on a line horizontally drawn from where the femoral artery crosses the pubis, to the greater trochanter, to the depth of five to seven centimeters (2 to 3 inches). He claims that failures occur because the emulsion is deposited outside of the joint, the needle not having been properly inserted.

*Excision.* A summary of opinions relative to operative interference is given us by Lovett, and it is toward conservatism.

Vincent states that in the Lyons Charity Hospital, 52 cases were excised out of a total of 233, or 22.3 per cent. Lovett, states that of 1100 cases treated at the Boston Children's Hospital 50 excisions were performed, or 4.5 per cent. Lovett shows by quotation, that whereas Germany was resection mad they are now as conservative as America. Further quotations are made to demonstrate the same trend of procedure.

Lovett analyzes 50 cases and adds:

"The indications for abandoning conservative measures for operation, have been, in general, as follows :

(*a*) Persistent failure of the general health.

(*b*) A progressive destructive process in the joint, which continues in spite of favorable therapeutic conditions. This is made evident by much induration and multiple indolent sinuses through which the products of the disintegration drain rapidly away.

(*c*) The persistance of severe pain and excessive tenderness late in the disease, which are not affected by efficient traction and fixation.

(*d*) Formation of extensive sequestrae in the joint.

The age of the patients at the time of operation was as follows :

| | |
|---|---|
| Two years | 2 |
| Three years | 1 |
| Four years | 6 |
| Five years | 4 |
| Six years | 9 |
| Seven years | 6 |
| Eight years | 6 |
| Nine years | 2 |
| Ten years | 6 |
| Eleven years | 3 |
| Twelve years | 3 |
| Not stated | 2 |

"The duration of the disease at the time of operation, as estimated from the statements given by the parents, would be of little value and would make the time too short in most cases. The duration of several cases in the group is, however striking :

Four had lasted..... 3 years at least.
One had lasted..... 4 years at least.
Two had lasted..... 5 years at least.
One had lasted..... 6 years at least.
One had lasted..... 8 years at least.
One had lasted..... 9 years at least.

"Finally, of the fifty cases, nineteen are dead ; of the remaining thirty-one, three were doing poorly when last heard from (six months after operation) and probably died. Others were heard from as doing well, as follows :

One..... 4 months after operation.
Five..... 6-8 months after operation.
One..... 9 months after operation.
One..... 10 months after operation.
Two..... 12 months after operation.
One..... 18 months after operation.
One..... 24 months after operation."

Townsend, states that from 1888 to 1896, 2295 hip cases were treated in the Hospital for Ruptured and Crippled, and that 121 excisions were performed on 119 patients making about 5 per cent of operations. He further states that 78 were males, and 41 females. The right hip was removed in 69 operations, the left in 52. In 24 the anterior incision was made use of, and in 97 the posterior.

"Of the 121 excisions it has been possible to trace but 101. Of ninety-nine patients traced, fifty-two are known to be dead ; and these include two cases in which both

hips were removed. Of these fifty-two deaths, fifty-one were attributable to the diseased condition present and one to accidental drowning.

"Of the fatal results, thirty-seven occurred within six months after the operation and ten more within one year. In nine cases of shock, death occurred within forty-eight hours.

"In ten patients the limb was extended to 180 degrees; in six, to 170 degrees or over; in seven, to 165 degrees, and in six, to 160 degrees. These twenty-nine may be said to have the limb in a position that makes locomotion easy, and are cured without flexion-deformity. All beyond this have flexion and some lordosis as a result. The amount of motion in the joint varies; in one it is 130 degrees; in three the limb can be brought to a right angle (90 degrees of motion); six have from 30 degrees to 40 degrees; eight have from 5 degrees to 30 degrees, and in twenty-six there is no motion.

"Of the forty-seven patients known to be living, we have found twenty-six cured. Of the remaining twenty-one, fully one-half are in bad condition, and will die from exhaustion if not from other causes, as the result of long-continued suppuration. Of this number, in two the sinuses are still discharging, six years after the operation; in one, after five years; in two, after four years; in one, after three years; and in two, after two years. In the remaining cases too little time has elapsed since the excision was done to allow of a final report being made. The results may be stated as twenty-six cures after 101 operations, and we have reason to believe that of the patients not traced many are living."

"Sherman states that in 147 hip cases, 64 excisions

have been performed. Of these he is able to furnish subsequent records of 34 as follows: "13 are dead; 2 from operative shock; 1 chloroform narcosis; 2 tubercular meningitis; 7 general tuberculosis; 1 pulmonary tuberculosis. Thirteen of the excised cases are still under treatment. Average measurements in 34 operative cases is, maximum shortening $3\frac{3}{4}$ inches; minimum shortening $\frac{7}{8}$ of an inch, average 1.98 inches. Average flexion 112 degrees; average extension 174 degrees. In all but five the extension was full 180 degrees. Average adduction 29 degrees.

In the cases treated mechanically the following may be given.

Average shortening 1.83 inches; average flexion 67 degrees; average extension 145 degrees."

From the foregoing tables the following may be given:

Average age at which excision was performed....8 years.
" time cases had been under treatment....5 "
" amount of shortening.....1.7 inches.

## SPONDYLITIS.

**Spondylitis** is also known as Pott's disease, angular curvature, tubercular spine disease, and vertebral arthritis. It is a tubercular disease of the vertebral column, destroying one or more of the bodies and intervertebral substances, and resulting, in the majority of cases, in angular deformity. It embodies 15 per cent. of all orthopedic cases and 25 per cent. of all tubercular bone and joint diseases.

**Causes** are *predisposing*, as a tubercular history which is found in 80 per cent. of all cases, and a depraved condition of the system; and *exciting*, as slight injuries from falls, pneumonia, typhoid fever and the eruptive fevers. *Age.* It may occur at any age but is most frequent between the ages of three and twelve years; 80 per cent. occur under 14 years, and but 4 per cent. over 21 years, and the author has one case 11 months, and another 42 years. *Sex.* 55 per cent. occur in boys because they are more active than girls, and more liable to receive injury. *Location.* 50 per cent. are in the dorsal, 36 per cent. in the lumbar, and 14 per cent in the cervical regions. It attacks the individual vertebrae (Bilroth) as follows: 6th dorsal, 2nd cervical, 5th, 7th and 8th dorsal, 3rd cervical, 3rd, 4th, 9th and 10th dorsal, and 4th lumbar. According to Huter the 11th and 12th dorsal are most frequently diseased, and next the 1st lumbar. Nebel also states that the lumbar vertebrae are most frequently diseased.

**Pathological** changes which occur are destruction

of the body of the vertebra with interstitial absorption of the cancellous structure, generally of the anterior portion of the body. The process of destruction may begin in the inter-vertebral fibro-cartilage and extend to the bodies, but this is an unusual course.

The latter variety generally terminates in caries sicca. Suppuration or abscess formation occurs in about 50 per cent. of cases as demonstrated post mortem, but in cases which recover abscess is discovered in about 10 per cent., a greater percentage occurring in lumbar disease, and only about 8 per cent. in cervical cases.

Fig. 57 shows a specimen in the writer's hands. The subject was a woman about 90. Three points of disease will be seen, at A, B and C. There is also lateral curvature of the spine. No history was obtainable.

**Symptoms.** It is quite usual that Pott's disease is not recognized until deformity occurs, so obscure are the early symptoms. General debility, irritability, lack of energy, and a desire to lie about, are the first conditions to be found.

*Pain* may be absent, but is usually present, not at the focus of disease, but at the terminal of the nerves given off at the point of disease. In cervical disease the pain will be in the throat and upper extremities, in dorsal disease, over thorax and epigastrium, in lower dorsal disease, over the abdomen and in lumbar disease in the pelvis and lower extremities.

*Fever* is seldom recognized but is usually found during the afternoon, lasting for two or three hours, rarely rising above 100° F., except during abscess formation, when it may be 103°, but it drops as soon as the abscess escapes from the original focus into less compact surroundings.

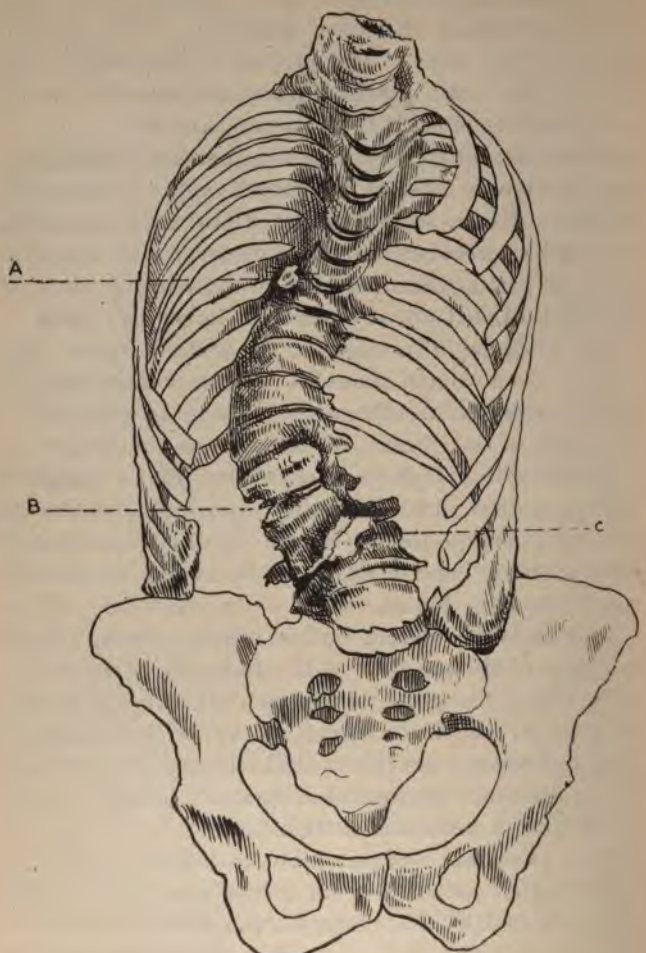



FIG. 57.

**Examination.** In making an examination the patient should be stripped and the attitude studied, while walking, stooping and standing. In the cervical region the patient grasps the head with the hands and the head is in wry neck. In cervico-dorsal disease the chin is elevated, neck forward, shoulders drawn up, and the spine below generally straight. In dorsal disease the hands rest upon the hips or against something

FIG. 58.

(Fig. 58.) or when sitting they support the chin. The spine is curved above and below the diseased area, shoulders elevated and body shortened. In lumbar disease the body is thrown forward, the hands rests on the thighs, or one leg may be drawn up. There is a military attitude, giving evidence of rigidity of the spine.

*Rigidity* is an important diagnostic symptom which is always present. If patients are asked to pick up objects from the floor they hold the spine straight and bend the hips and knees, while in hip disease the spine and knees are bent and the hip is held rigid. Rigidity is best tested by placing the patient on the face on the examining table, rest one hand on the scapulae and grasp the heels by the other hand. (Fig. 59.) Now

FIG. 59.

swing the feet from right to left, and elevate and observe whether the spine bends as it does in a healthy child. In almost all cases, especially of the lower dorsal and lumbar regions, the body is thrown slightly to one side, a condition caused by a greater destruction of the body of the vertebra on one side than the other. Woley, of Chicago, analyzed 84 cases and found rigidity in all. Pain in 50 per cent. of cases is generally remote from the diseased area, and in 20 per cent. is in the abdomen. 76 per cent. of the 84 had kyphosis as follows: 32 in dorsal, 21 in dorso-lumbar, 19 in lum-

bar, and 5 in cervical. 15 had Psoas abscess, all in children under 10 years, as follows : 5 in lumbar, 3 in cervical. 20 per cent. had Psoas contraction. 3 had Pott's paraplegia. Sayre reports 4 cases of cervical spondylitis with the following observations ; "Swelling on line with 2nd cervical on right side of neck, chin directed toward the right side of body, face looked downward, and the left ear was thrown toward the left shoulder. The chin was so depressed as to make swallowing difficult."

**Deformity** is always diagnostic and it may be found early. The angle in dorsal disease is acute, while in cervical and lumbar disease it is not so marked and

FIG. 60.

SHOWING LORDOSIS.

FIG. 61.

FIG. 62.

KYPHOSES IN LUMBAR POTTS.

FIG. 63.

PSOAS CONTRACTION, DUE TO LUMBAR DISEASE.

may be absent. In the majority of cases the deformity developes gradually, and in cases running a mild course it may not be discovered for months after the onset of the disease. The deformity is due to softening of the bodies of the vertebrae. In the cervical region the prominence is forward. In dorsal disease the kyphose is backward and in lumbar disease it is generally backward but it may be forward, when it is called *lordosis.* (Fig. 60.) Lateral flattening of the thorax and pigeon breast are late deformities. So general are the symptoms manifested in Pott's disease that it has been confounded with almost every other disease. Ridlon reports two cases of Pott's disease which had been treated for lateral curvature, and Kermission reports five cases in which the same mistake in diagnosis had been made.

CASE. 12. Essie, aged 5, treated one year by several doctors for all varieties of intestinal, stomach, abdominal and urinary diseases, when first seen by the writer, a kyphosis was very perceptible. The disease was located in the first lumbar vertebra. The abdomen was enormously enlarged, the walls very tense, *caput medusae* very distinct, great pain over abdomen, and marked constitutional disturbances. An abscess was distinctly outlined in the false pelvis. It did not, however, present itself below Pouparts ligament. It entirely disappeared without producing further complications in the course of a few months. The patient has constantly worn an adjustable plaster-of-Paris jacket, day and night, and has never been allowed to stand on her feet for one moment without the jacket being on. The deformity has decreased so that now a tracing shows almost a straight line, and the patient is an advanced convalescent. See Fig. 64 A.

*Paralysis* as a complication of Pott's disease is more frequent in upper dorsal disease. In this locality

it occurs in about 20 per cent. of cases, while in lumbar disease it occurs in about 4 per cent. It is due to pressure myelitis and meningitis, and not to the pressure of the bones in their deformed condition upon the cord. It is generally bilateral, although it may be on but one side. Cases with marked deformity are not more liable to have paralysis than those with slight kyphoses. Paralysis may occur at any time during the course of the disease. Its duration is about six months, although a few cases have been reported where it lasted several years. Degeneration and destruction are due to the pressure and non-use of the muscles, and not to any actual pathological changes in the cord. Early treatment properly applied greatly reduces this complication. It is almost always in the neglected cases that paralysis occurs. In paralysis, tendon reflex is exaggerated, and in some cases it becomes quite annoying.

The following are typical cases of Pott's paraplegia and may be perused with profit.

CASE 13. Girl aged seven years, was suffering with advanced disease of the third, fourth and fifth dorsal vertebrae, with a marked kyphose. The patient had been completely paralyzed for about six months, there being no ability to even move a toe. Moderate extension was applied to the spine by securing the head to the head of the bed by a band, counter extension being made by means of a rope and pulley extension secured to the pelvis by a pelvic band. The child was given, as recommended by Gibney, saturated solution of iodide of potash, increasing the dose from 15 to 90 grains a day. Throughout the course of treatment the Faradic current was used daily. The patient skipped into my office in three months completely recovered.

CASE 14. Boy aged 5 years, (shown in Fig. 62) with disease of middle dorsal vertrebra when first seen, with the usual history extending over a period of four years. No ab-

FIG. 64.

TRACINGS BEFORE AND AFTER TREATMENT IN CASES 12, 15 AND 17.

scess has ever presented itself to the surface. Paraplegia was developing, and in the course of a few weeks was complete. Under recumbency, iodide of potash in large doses and tonics, the patient entirely recovered in five months.

CASE 15. Annie G , aged three and a half years, was first seen January, 1897, at which time she was confined to her bed and had been unable to walk for about five weeks on account of paresis of the lower extremities. A plaster-of-Paris jacket was adjusted and in one week she was running about the house. In two months the case developed a psoas abscess, which presented itself below Poupart's ligament the size of half of a large orange. This could be distinctly outlined in the pelvic cavity before it presented itself below Poupart's ligament. In fifteen months after treatment was instituted the abscess had entirely disappeared, excepting slight induration of the psoas muscle, deep down in the pelvis. The abscess received the usual treatment of aristol and lanolin ointment, as described. The deformity at the time of the beginning of treatment, and that after nineteen months treatment is shown in Fig. 64 B. A convalescent brace (Taylor's) was applied after thirteen months use of the jacket.

*Pott's Abscess.*—In addition to what has been said under tubercular abscess, special attention should be called to the location of these abscesses. In *cervical* disease they point along the side of the neck, into the thoracic cavity, or into the esophagus. When the disease is in the vertrebral bodies just back of the pharynx, the abscess not infrequently pushes this structure forward, even interfering with breathing or swallowing, occasionally breaking into this cavity. A digital, or ocular examination of the pharynx will reveal the abscess. In *dorsal* disease it points along the spine, or into the thoracic cavity, finding its way down to the diaphragm. In *lower dorsal* disease the usual course is along the psoas muscle, even down to, or below, Poupart's ligament. In *lumbar* disease the abscess

may follow the psoas muscle or it may come to the surface over the sacrum. In all cases of lower dorsal or lumbar disease the iliac fossæ should be examined for abscess. In some instances this is one of the symptoms that confirm a diagnosis when others are wanting, as the following cases show :

CASE 16. Girl aged three years, referred to my orthopedic clinic at the Ohio Medical University as a case of hip disease. The patient had an abscess as large as an orange on the inside of the thigh over the adductor muscles and freely below Poupart's ligament. There was limited motion in the hip, but no rigidity, which condition led me to look elsewhere for the primary focus of disease. An inspection of the spine revealed a very slight kyphose in the upper lumbar region. This case had been wearing a fixation hip brace, and the attendant, even after some weeks of observation, thought there was hip disease along with Pott's, but aspiration of the abscess and the subsequent history demonstrated to him that no hip disease existed.

CASE 17. Bessie K., aged five years, came under observation September, 1897, in the first stage of lumbar Pott's disease with very slight knuckling of the spinous process of the first lumbar. Spine rigid, patient in fair health. The patient was limping considerably, the right thigh was adducted, flexed and rotated inward. So marked was this that an inspection would lead one to a diagnosis of hip disease, as the attendant had insisted. In this case, as in the preceding there was limited motion of the hip, but no rigidity. Hip disease was excluded. The hip symptom was due to the existence of an abscess burrowing along the psoas muscle. This proved to be correct, as the abscess two months later presented itself in the pelvis above Poupart's ligament. It elevated the skin at this point above the normal line about an inch, and under ointment and massage disappeared. She has worn an adjustable plaster-of-Paris jacket day and night. The hip symptom disappeared and no hip disease exists beyond the abscess in the sheath of the psoas muscle, which limited the range of motion in the joint. The tracing in Fig. 64 C shows the amount

of deformity present at the beginning of treatment and the improvement which took place in eleven months.

A **differential diagnosis** must be made from the following diseases, named in order as they appear from above downward: torticollis, occipital neuralgia, bronchitis, pneumonia, pleurisy and empyema, emphysema, thoracic aneurism, gastric and intestinal diseases, summer diarrhea, worms, abdominal aneurism and tumors, floating kidney, pelvic disease, rickets, infantile scorbutus, hip joint disease, sacro-iliac disease, rheumatoid arthritis of spine, scoliosis, infantile spinal paralysis, hysterical spine, muscular rheumatism, disease of uterus and appendages, cystitis, stone in the bladder, bubo, hernia and tumors.

CASE 18. J. H., aged forty-two, had been suffering with neuralgia of the upper extremities, upper thoracic region and stomach symptoms for eight years and had, of course, received all varieties of treatment. Pott's disease of the fourth dorsal vertebra was recognized, and an adjustable plaster-of-Paris jacket, with anterior chin shelf, gave him relief. As a means of confirming a diagnosis the patient was ordered to bed for one week. If it were a case of Pott's disease the rest would relieve the pain, which it did. The pain before the adjustment of the support was intense, but since then he has been able to continue his pursuit as a professional man without interruption. I desire here to call attention to the particular point that with a jury-mast he would not have been able to continue his calling, but as the anterior chin support is almost entirely hidden by a high collar, his support attracted little attention.

CASE 19 recently came to me, aged 25, who had been wearing a plaster-of-Paris jacket for six months for supposed spine disease, A thorough investigation revealed an enlarged ovary, which proved to be a hematoma. She also had two floating kidneys.

Diseases of the stomach and intestinal canal and early Pott's disease, present symptoms very much

alike and it is only after a critical examination of the spine and study of the rigidity that a differential diagnosis can be made.

Hip joint disease is very frequently confounded with Pott's disease with abscess. In a study of the hip symptoms a distinction must be made between rigidity and limited motion. (See hip joint disease, and cases 16 and 17 of this chapter.)

**Prognosis.** The ultimate outcome depends upon the time at which treatment is begun, the nature of the treatment, the faithfulness with which the parents, or nurses carry out orders. Cases when seen before marked deformity exists may go through the period of molecular disintegration, absorption and reconstruction without an increase of deformity. Especially is this true when the disease is located below the eighth dorsal vertebra.

Prognosis is more favorable in children than adults. Under proper treatment few die. Mortality in all cases is 20 per cent. It is more unfavorable in abscess cases, and the mortality increases if a discharging sinus exists either after operation, aspiration, or spontaneous rupture. A residual abscess may become active at any time.

*Death* results from secondary deposits in the lungs, etc., amyloid degeneration of viscera, excessive suppuration and mixed infection, pressure of abscess upon, and rupture of blood vessels, rupture of abscess into pleura, peritoneum, esophagus, or bladder. The cases which recover with slight deformity have the usual expectancy, or attain an average age of forty-nine years. The average length of *time* these cases are under treatment is three years, although some recover in one year

and others with discharging sinuses may be under treatment eight or ten years.

**Treatment.** Here, as in the management of all other tubercular bone diseases, generous diet, tonics and outdoor exercise to keep up the general health of the patient, must be given. When hereditary syphilis is suspected, or when evidence of so-called "struma" exists, iodide of iron and iodide of potash should be administered, when marvelous improvement will be observed and cases will recover in half the usual time. Paskeneski reports 8 cases of syphilitic Potts, five of which were completely relieved by active anti-syphilitic treatment.

*Counter irritants*, as introduced by Mr. Bott, have no place in the list of modern methods of treatment.

*Rest* is the principal means of treatment. This may be obtained in recumbency, and by the use of jackets, braces, etc. Recumbency, the method of the early surgeons, is again coming into use. This is the only means of securing absolute rest to the diseased vertebrae, allowing the destruction, molecular disintegration, absorption and reproduction to occur, and the spine still remain in a normal position.

Sayre, the father of orthopedic surgery, in his invention of the "turtle back" which was soon transformed into the plaster-of-Paris jacket, placed the treatment of Pott's disease upon an entirely new and rational basis. It was a transformation from practically no treatment, to a perfect treatment, indeed so perfect that the ingenuity of all his followers, imitators and critics, has been unable to make any improvement. Sayre, some years ago, called attention to embarassment of respiration, frequent heart,

etc., which completely disappeared during suspension and did not return so long as a perfect fitting jacket was worn. So severe is the dyspnea in some cases that it is thought that a foreign body was in the air passage. Lavrand reports a case of cervical Pott's which had

FIG. 65.—JURY MAST AND RAWHIDE JACKET.

asphyxic seizures which were relieved by the adjustment of a jacket and jury mast. Casse, of Brussels, reports six cases where traction relieved the symptoms and claims that all cases should have traction with immobilization.

The experiments of Lovett and the deductions of Schapps and others, clearly demonstrate that braces do not keep the spine absolutely erect. Lovett shows

that the height in Pott's cases increases from one-fourth to seven-eighth of an inch from standing to recumbency, and have as good general health as cases which are given ambulatory treatment. Schapps has devised a gas pipe carriage hammock for the treatment by recumbency, which is admirable and efficient. These writers insist upon recumbency during the first stage. For the ambulatory treatment Schappe has made slight modifications of the Taylor brace.

When the disease is located above the seventh dorsal vertebra a head support should be worn. This may be a Sayre jury mast, (Fig. 65) a Shaffer support, (Fig. 66) or any variety of head sup-

FIG. 66—SHAFFER HEAD REST.

port. The essentials in the adjustment of head supports for disease of the first seven dorsal vertebra is that the

supporting point should be the pelvis, the counter support be the occiput and chin, that it is sufficient at all times, and that the antero-posterior leverage is maintained constantly. During the course of active

FIG. 67—TAYLOR BRACE.

bone disease of the spine, the patient must not be permitted for one moment to stand without the spinal support. The change of clothing, the bath, etc., should be given with the patient in recumbency, and the brace or jacket applied with the patient in the same position.

*Braces* are numerous, but the original idea of Taylor combines the principles of them all (see Fig. 67). This gives antero-posterior support to the spine. The inferior point of pressure is made transversely across the posterior part of the pelvis, and to the spine on either side of the spinous processes. To this is added an anterior apron and arm straps. Hoadly, of Chicago, uses an anterior wire frame which makes pressure against the upper portion of the sternum and the anterior superior spines. The counter pressure is made by a broad cloth band, which passes posteriorly across the kyphose from the uprights of the wire frame. In

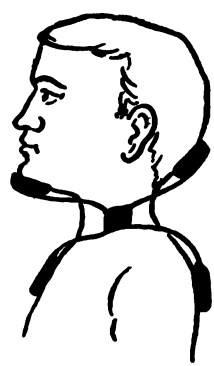


FIG. 68.

ORIGINAL HEAD SUPPORT.

cases where the disease is above the seventh dorsal vertebra, a head support is demanded. The jury mast of Sayre Fig. 65 has stood the test very well and is used by many. Nothing has ever been introduced which will give sufficient support and at the same time allow

freedom of the head, and when the disease is in the upper dorsal region this is quite desirable. Other head rests have been introduced by Shaffer, Taylor, Goldthwaite. Beely, Owen, Thomas, Burrell, Bradford and Lovett, and the writer.

FIG. 69.

JACKET AND CHIN SHELF.

In cervical disease the ordinary spinal brace does not have to be used, as the support can be secured from the shoulders. For this purpose a Thomas, Burrell or Robert's collar, or the one used by the author (Fig. 68) may be used as may be selected by the surgeon. Lovett, in a recent paper, after demonstrating by the use of models, theories as to the proper method of con-

structing spinal supports, states that plaster-of-Paris is the best, and that when a head rest is required it should be made to extend from the jacket anteriorly and rest under the chin.

An anterior chin shelf is shown in Fig. 69. Two

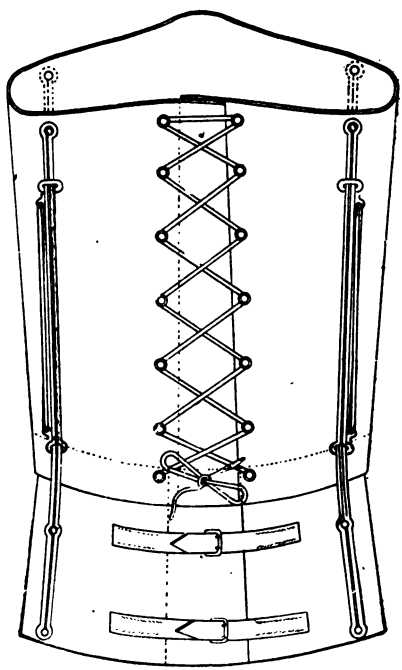


FIG. 70.

ELASTIC TRACTION SPINAL BRACE.

pieces of strap iron are worked into the jacket and extend from the anterior superior spines to near the upper margin of the jacket about two inches from the median

line. In the upper ends of these bars are screw holes to which are secured the lower ends of the chin shelf. The two rods are used so that uniform support may be given and in order that the jacket can be made adjustable, so as to permit its removal for the bath, etc. To my mind there can be no question as to the superiority of this form of head support over the jury mast. It is perfectly rigid. The line of support comes directly from the anterior superior spines to the head and the height is the same at all times, while the jury mast furnishes support to the head through a long bow which cannot be made rigid unless very heavy, and the support is indefinite, varying as resiliency takes place. Besides this the buckles which extend to the chin piece are easily changed by the patient or mother, as may be the pleasure or whim of the patient. In addition to all these there is nothing so unsightly in surgery as a jury mast, while the chin shelf is only seen as a pad under the chin this being easily hidden by a high collar. From the writer's experience he is free to say that it gives perfect support, relieves pain and prevents the head from dropping forward.

To avoid the traumatism to the spine incident to locomotion, Dr. John C. Schapps suggests that these patients should use rubber heels on their shoes.

After having presented the various methods of treatment, the writer desires to outline the following rules:—

*First.* For the mechanical support of Pott's disease below the seventh dorsal vertebra, the plaster-of-Paris jacket of Sayre is the best support now known.

*Second.* It should be worn day and night from the earliest incipiency until all active symptoms have subsided and convalescence is well advanced.

*Third.* During convalescence the Taylor brace is to be preferred.

*Fourth.* For cervical diseases, a Thomas collar or the brace shown in Fig. 68 make ample support.

*Fifth*—For upper dorsal disease the plaster-of-Paris jacket with the anterior chin shelf is to be preferred.

### PLASTER-OF-PARIS JACKETS.

Regarding suspension preparatory to the application of a jacket, Sayre says: "Suspend the patient until the point of entire freedom from pain is reached; stop here and at once apply the jacket." The patient is either suspended, as directed by Sayre, in the tripod or, as is the practice now, placed in the horizontal position. The horizontal method is undoubtedly preferable in children, because the fright caused by the process of hanging is avoided, and it is to be preferred since it places the spine at rest and muscles are completely relaxed. The frame of Bracket, of Boston, has been in service in my practice for some time and is quite satisfactory. The frame is made of ordinary gas-pipe and supported on the horizontal, either on stools, tables, etc., or by some especially arranged device. Across the frame heavy muslin is stretched, very tightly. Neatly fitting stockinette, twice as long as the intended jacket, is put on the patient and secured over the shoulders and below the perineum. The patient is now placed upon the canvas, either on the face or back as desired. With a pair of scissors elliptical openings are cut out of the canvas on either side of the body from the axillæ to the trochanters. Extra supports of several folds of muslin or webbing are stretched across the frame under the head, shoulders and pelvis.

FIG. 71.
MODIFIED HEAD REST AND PLASTER-OF-PARIS JACKET.

FIG. 72.
SAYER'S TRIPOD, USED IN APPLYING PLASTER-OF-PARIS JACKETS; ALSO METHOD OF SELF SUSPENSION.

FIG. 73—MODIFIED STRETCHER.

More recently the writer has been using, instead of gas-pipe a wooden frame, underneath which spikes are placed pointing inward at an angle of 45°. The muslin is drawn around the sides and ends of the frame and hooked over the spikes. In this way a more uniform tension can be obtained than is possible with safety pins over the gas-pipe frame. (See Fig. 73.) To reinforce the canvas two bands of heavy webbing are buckled around the frame above under the throat and shoulders, and below under the pelvis. After adjusting pads of piano-makers' felt along the spine and around the iliac crests, the bandages are applied, beginning below on a level of the trochanter. As they pass underneath the body they include the strip of canvas left between the fenestræ.

FIG. 74—METHOD OF APPLYING JACKET.

The bandages should be lapped about two-thirds and extend up to the axillæ, beginning with the second bandage at the end of the first. Experience alone can indicate how many bandages to use for a case. For a child five years old, five bandages, two and a half

inches wide by five feet long, will make a jacket sufficiently heavy, and in Case 18, eighteen bandages were required. Just as soon as the jacket is hard enough to stand alone it is cut off, along the anterior median line, removed from the body, the cut edges brought together and held so by a roller bandage. After baking by a slow fire to thoroughly season so as to make it elastic and durable, it is trimmed under the arms and below, so as not to interfere with thigh flexion. It is finished by bringing the projecting ends of the stockinette from above and below over the outside of the jacket and stitching. The margin of the jacket should be well padded under the arms. The stockinette is also stitched over the cut edges, along the anterior opening. Two strips of leather as long as the jacket, containing shoe hooks one inch apart, are stitched to the edges. It is now ready for adjustment. This is done by sliding it up over the feet and pelvis, which manipulation preserves the jacket.

### RACHIOTOMY, OR LAMINECTOMY.

*Operation for paralysis.* Roberts, of Philadelphia, and Phelps, of New York, have done laminectomy for Pott's paraplegia by removing two or three vertebral arches. Menard, of Berk-sur-Mer, and Vincent, of Lyons, advocate direct opening into the focus of disease in the body by a lateral incision and resection of the transverse process and ribs. Arbuthnot Lane reports a case of paraplegia relieved by removal of the fourth, fifth and sixth laminæ and spinous processes. On the fourth day after the operation the patient was able to move his legs. The eneurisis which had been present soon improved and in one month power had re-

turned to all parts. Further operations have been performed by Macewen, Thompson and Figeutia. Samuel Lloyd, of New York, analyzed seventy-four cases of laminectomy for Pott's paraplegia and decides that this operation should be done, "(1) when posterior spinal disease is the cause; (2) when there is dislocation or pressure of a sequestrum; (3) when under proper medical and mechanical treatment the symptoms increase; (4) after eighteen months of treatment there is no improvement; (5) when pressure myelitis threatens the integrity of the cord."

Thorburn, of London, states that the most usual cause is pressure upon the cord at the seat of the disease by granulation tissue, but it may also be due to hemorrhage, or bursting of an abscess into the spinal canal, or displacement of a sequestrum which presses upon the cord. He concludes his paper by making the statement that mere kyphosis is not sufficient to produce paraplegia.

The proper treatment of Pott's disease is to prevent deformity during the early course, or to correct a minimum of deformity, and the practitioner who sees these cases growing progressively worse, and still holds on to them, is responsible for the deformity.

*Rachiocampsis*, or forcibly but gradually reducing the deformity of Pott's disease, has been practiced as a method of treatment for years by the writer and by many others. It is expected especially in cases of lower dorsal and lumbar Pott's, during the early course, and before the kyphose is large, to have the deformity diminish instead of increase. This has been accomplished by placing the patient in such a position during the time the jacket is applied, as to gradually force the spine a little straighter in each jacket.

*Rachioclasis.* Calot concluded that the deformity of Pott's should be reduced at once under an anesthetic and by making forcible traction upon the spine in the long axis, while the surgeon makes direct pressure upon the apex of the kyphose to reduce it. In almost all cases the deformity can be overcome and in paraplegias the paralysis is frequently benefited by the proceedure. The reviver of the operation reports 300 cases showing marked improvement. In this country John Ridlon, Leonard Freeman, A. M. Phillips and others have practiced correction, both by immediate and gradual reduction. All of these cases are still under treatment and until sufficient time has elapsed to demonstrate its advantage, no claim can be made for it. In bad deformities it would appear that when the spine is straightened the lateral articulating processes, acting as a fulcrum, throw the remaining bodies of the vertebræ apart, thus leaving a gap where the bodies have been destroyed to be filled in. If this occurs at all, it must necessarily take months, during which time the greatest care in the management of the mechanical treatment must be observed.

A Chipault insists that after forcible correction of the spine per the method of Calot, that the spinous processes should be wired one to another, so as to forcibly hold the spine straight, and this operation has been practiced by several American surgeons, notably Phelps. Calot, thinks that patients should be kept in plaster-of-Paris for eighteen months after forcible correction, and claims that firm consolidation does take place in the majority of cases. This is contradicted by Cheyene, and many others. It is gratifying to note that the operation is comparatively free

from danger, and out of three hundred cases, reported by Calot, but two resulted fatally, and that there were very few accidents. In eight paraplegics the paralysis disappeared, and in six within ten days, showing the positive benefit resulting from the correction.

Freeman, may be quoted as follows :—"Theoretically the advantages of Calot's method are (1) immediate, complete or partial correction of deformity ; (2) removal of pressure and irritation from the cord, resulting in some cases in relief from neuralgia and paralytic symptoms ; (3) separation of the diseased surfaces of bone, thus avoiding pressure and irritation which are supposed to favor continuance and spread of disease ; (4) gain in length of the spine ; (5) avoidance of malformation of the chest walls and injurious alteration of the position of organs.

"The disadvantages which have been claimed are (1) production of a large cavity which may not fill up with sufficiently firm tissue ; (2) non-formation of supporting masses of new bone and consequent weakness of the spine and recurrence of deformity ; (3) rupture of tubercular material into the mediastinum ; (4) increase of the disease by local injury, separation of fragments of bone, etc., (5) production of tubercular meningitis, or of general tuberculosis ; (6) injury to the cord or to its membranes ; (7) production of abscesses."

# INTERNAL DERANGEMENTS AND DISEASES OF JOINTS.

## SYNOVITIS.

**Synovitis** has been variously known as hydrops articuli, tubercular hydrops, sero-synovitis, tubercular empyema of the joints, etc. It is an acute or chronic inflamation of the synovial membrane, which may be specific or tubercular, or due to trauma, or to pathological changes. The synovial sac, lined with a serous membrane made of elastic and connective tissue lined with one layer of endothelial cells, is highly vascular and well supplied with nerves. It lines the joint bag in all its deflections but it does not cover the interarticular cartilage but terminates at its edge. Normal synovial fluid is clear, alkaline, with an oily feel, the color of the white of an egg, and contains albumin, mucin, oil cells, leucocytes and epithelium.

Hofbauer states that "this membrane not only differs from other serous membranes by the lack of endothelium, but by a peculiarly rich and elbow-shaped vascularization. The capillaries are extremely numerous and penetrate close to the surface, under which they bend and extend in a tortuous course parallel and very close to the outer surface. This arrangement of the capillaries explains the tendency of the articulations to be early involved in the course of any infection of the

blood, owing to the great afflux of blood and of the contained irritant substances, leading to accumulations of the microbes, or toxins in the synovia and joint. The extremely thin partition is soon traversed by chemicals, or microbes, in the same way as they pass into the urine through the glomeruli, although less easily. The contaminated fluid has then no outlet and everything favors the developement of the germs, as absorption from the articulations is extremely slow."

Five **varieties** may be described, viz.: 1st, serous (hydro-arthrosis); 2nd, purulent; 3rd, fungoid, 4th, dry synovitis. A fifth variety, which may run a more acute and independent course, or may present symptoms included in the above classification, embrace those due to injuries and sprains.

**Causes** which are responsible for this condition, named in the order of their importance, are tuberculosis, trauma, including sprains, overexertion, exposure, acute articular rheumatism, gout, gonorrhea and syphilis, and the acute diseases, as scarlatina, typhoid fever, puerpural fever, pneumonia, diphtheria, etc. A frequent source of acute synovitis is infection from punctured wounds of the joint.

The **pathological** changes which occur in synovitis may be enumerated as follows: hyperemia of synovial membrane with stasis of blood current, accompanied with dilatation of capillaries, escape of leucocytes and hypersecretion of synovial fluid, followed by thickening of the synovial membrane and periarticular structures. In the subacute or chronic cases of purulent synovitis there is exfoliation of pieces of membrane and cartilage, with a deposit of vascular granulations throughout these surfaces. The fungoid variety is a

further development of the granulations just mentioned, and is always secondary to the first and second varieties, or to osseous disease.

A variety of synovial disease has been described under the head of "*Hydrops articulorum intermittens.*" As the name suggests it is an intermittent or periodical accumulation of fluid in the joint (generally in the knee), associated with great pain. The accumulation, which is large, is after a week or so absorbed, only to recur again in from four to six weeks of quiescence during which time the joint is normal. In the cases reported aspirations had little effect, and in one case in which an open operation was done the destructive process was so great as to require amputation. The condition is by some considered the premonitory symptoms of grave joint changes, while by others it is considered a neurosis. *Treatment* should be absolute rest with local blistering, with internal absorbants as iodide and mercury. Thirty-five cases are recorded. five of which were in this country.

**Arthritis Plastique Ankylosante** is a variety of inflammation of the synovial membrane not accompanied with the usual symptoms. These cases run a very chronic course, but have no swelling or accumulation of fluid in the joint. Pain, if present, is not very severe. Atrophy of the muscles is always found. The low grade of inflammation appears to obliterate the joint cavity, and an ankylosis, generally fibrinous, is the result. Rheumatic or specific history is not found. *Treatment* is of little benefit except to temporarily check the progress of the disease and prevent deformity. When joints are in deformity, *brisment force* with cor-

rection is of benefit by placing the member in a more serviceable position.

Two cases of dry ankylosis have come under my care recently, one of the knee in a man of 40, and one of the elbow, in a girl of 13. The course was practically the same in both cases. In neither was there any swelling, tenderness, pain or abnormal accumulation of fluid in the joint.

**Symptoms.** When a sequel of gonorrhea, trauma, or the fevers, the disease develops rapidly, pain is severe, temperature above 100° F. Accumulation in the joint results in distension of the capsule in the direction of the least resistance, followed by general tumefaction of the joint. Local elevation of temperature with redness is usual. In knee joint disease, distension is on the sides of the patella, which is found floating; in wrist on dorsum; in ankle, in front of the tips of malleoli; in shoulder, in front of deltoid. Inflammation and distension of the joint bag by hypersecretion of synovial fluid results in a reflex nervous disturbance, putting all muscles which pass over the affected joint in a state of spasmodic contraction, which, as can readily be seen, increases the pressure of bone against bone and in this way increases the injury to the inflamed synovial surfaces, and this in turn increases the muscular spasm, and so on. This condition of increased joint-pressure results in trophic changes, and all the muscles that pass over, or whose tendons cross the affected joint undergo a perceptible atrophy in a few weeks after the onset of the disease. The greater the degree of inflammation, the more rapid the synovial accumulation, the greater the muscular tension and atrophy; and these symptoms all increase

in succession, so that in a very short time the patient is confined to bed with pain almost unbearable, inability to move the affected member, loss of appetite, fever, emaciation, etc. The beginning of purulent synovitis is marked by rigors, severe chills followed by high temperature and an exaggeration of the local symptoms. In chronic serous synovitis the onset is gradual and the symptoms, as they have been enumerated, develope more gradually.

**Diagnosis.** Manual extension is the most important diagnostic proceedure, and is accomplished as follows: Grasp the affected member with both hands, one on either side of the diseased joint, and if the trouble is in the synovial membrane, by making gentle but continued traction the muscular spasm will shortly yield, the joint pressure be removed in consequence, and the pain that is generally severe, entirely disappears. When the joint pressure is thus relieved, the patient's countenance will brighten up and there is freedom from pain. Now let go of the diseased member quickly, and allow the heads of the bones to go together with a thud, and watch the expression of agony on the patient's face. An elastic traction brace, properly adjusted, should afford just such relief, and when not so adjusted, cause such pain. This is of positive diagnostic value, and is only present in the trouble under consideration.

**Result,** in cases which recover, may be ankylosis, true or bony, false or fibrinous, with displacements, as subluxation in knee cases.

**Treatment** consists in local irritants, as blisters or liniments (equal parts of tinctures of iodine, belladonna and opium and glycerine), aspiration, injection,

elastic traction and absolute rest. Internally the patient should be given salines, mercurials, iodide of potash and iron. Locally the joint should be given absolute rest in an extended position. An *elastic traction* brace tends to relieve interarticular pressure. The apparatus consists of double bars, which are made to slide upon each other by the adjustment of elastics after the brace has been secured to the affected extremity, above and below the joint, by adhesive plasters. A knee brace is shown in Fig. 75. The

FIG. 75.—WRIST, KNEE AND SHOULDER BRACES.

side bars are made double and slide upon each other. The distal ends are the fixed points. Braces for the shoulder and wrist are shown in the same cut.

For the knee the brace terminates above in a Thomas ring, but the back part is left open, and the upholstering completes it. This makes the part under the leg soft and more comfortable while in the sitting position. It is fastened to the sole of the shoe below. In

wrist and other joints not affording pressure points for traction, the distal ends are secured to the member by adhesive plaster, which extends to the joint from both sides. Hooks project from the proximal ends of the parallel bars of the brace. As the elastics are thrown over the hooks the latter are brought closer together, thus throwing the distal ends farther apart; the distal ends being the fixed points traction is made upon the medium between them. Unless the appliance, brace, or whatever device used, does secure rest to the inflamed surface, we can hardly expect a satisfactory result. The intention of elastic traction is to put the joint at rest. We must not expect a severe synovitis to subside when the muscles in spasm are constantly tugging away and grinding the hyperemic and hyperesthetic synovial surfaces together with a force of many pounds.

For immobilizing the joint nothing is better than plaster-of-Paris applied around plenty of coarse cotton.

*Operative* procedures which are resorted to are aspiration and irrigation, peri- and inter-articular injections, arthrotomy and arthrectomy, and excision is occasionally called for, and in neglected or virulent cases even amputation may be required. After the abnormal fluid has been drawn from a joint cavity, two or three ounces of ten per cent. solution of iodoform emulsion should be introduced, and the joint kneaded so as to have the emulsion come into contact with all parts of the diseased surface. For the treatment of cavities of the body where aspiration, irrigation and medication by injection is desired, the quadruple-tipped aspirator head shown in Fig. 76 will add greatly to the convenience of the procedure. It permits the passage of the current

from any one to the other three tips by turning the central cylinder.

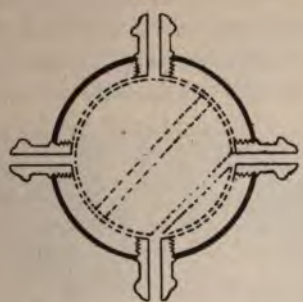


FIG. 76—QUADRUPLE ASPERATOR HEAD.

The following case of traumatic synovitis may be studied with profit:

CASE 19. H. S., aged five, fell from a fence and perforated the left knee joint by a sharp piece of glass. As is usual in such cases that do not fall into competent hands, and antisepsis is disregarded, an acute synovitis is the result.

When the case was first seen the joint was enormously swollen, much larger than shown in photograph Fig. 78. (Photograph was taken eight weeks after injury, or after patient was able to get about the house on crutches.) An elastic traction brace was applied, as shown, and the active symptoms soon began to subside. This case was not aspirated, but the wound was irrigated with bichloride 1-3000. When the acute symptoms had entirely subsided, and the wound had entirely healed, the brace was removed and the knee put up in plaster-of-Paris, which was left on for about eight weeks, when it was removed and the patient discharged. Photograph Fig. 78, A and B, shows the result. It will be observed that flexion is not perfect, but the range of motion answers all practical purposes and the patient walks without a limp.

**Gonorrheal Synovitis.** Statistics show that 2 per cent of all cases of gonorrhea have as a sequel some form of arthritis. Kœnig, of Berlin, believes that 90 per cent of all cases of synovitis of adults are associated with urethritis, and concludes that gonorrheal arthritis is the most frequent variety of synovitis.

FIG. 78—ILLUSTRATING CASE 19.

Women and men are equally affected, but

states that many cases of puerpural arthritis, as well as of chronic articular rheumatism in women, are gonorrheal. Usually but one joint is involved, but occasionally many joints are successively attacked, when the case is one of polyarthritis purulentia, or pyemia. The knee is the most frequent seat of the disease in men, and the wrist in women.

The **varieties** of gonorrheal joint disease are grouped by Kœnig as follows :

"1. Where simple effusion alone occurs.

2. With fibrin formation and capsular thickening.

3. The later condition associated with peri-articular phlegmons, with involvement of the tendons and ligaments.

4. A condition in which anklylosis occurs very early, with the deposition of much fibrin and infiltration of the ligaments. In all of these cases there is great tendency for the ends of the bones to grow together."

The **bacteriological** origin of idiopathic synovitis of adults can hardly be questioned. Nassa, of Berlin, made cultures of the secretions in 30 cases of suspected gonorrheal synovitis, and found gonococci in 19, and Bordoni-Uffreduzzi reports a case of gonorrhea complicated by polyarthritis in which the pus removed from a joint was found to contain gonococci. This writer inoculated the urethra of a subject with a culture taken from the second generation of these gonococci and succeeded in producing a gonorrhea. Kœnig advises that in any case of acute inflammation of the joint an examination and culture of the urethral discharge should be made. Jundell describes the first case of blenorrhagic teno-synovitis in which the

diagnosis has been positively confirmed not only by recognition of the gonococcus, but by its actual cultivation. The teno-synovitis was located in the sac of the posterior tibial muscle. The gonococci was found in, and cultured from, not only the pus, but also the granulation tissue from a cavity ten centimeters long. The gonococci were after culture, injected into the urethra of a moribund male and re-cultivated from the specific urethritis produced thereby. The relation of the gonococcus to synovitis presenting the clinical characteristics of blenorrhagic arthritis is considered by Respighi and Burci as indubitable, its presence being demonstrated by preparations and cultures. The gonococci are localized superficially in the synovia and tend to disappear rapidly by involution, but the process continues by evolution of the pathological alterations which it has caused on the surface of the serous membranes, and the products of its destruction may remain active. The absence of the gonococcus, often noted, may be explained either by the time at which it was sought for, or by the fact that it was limited by the free exudate.

The **symptoms** are similar to other varieties of synovitis, except that the course is more active and associated with chills, high fever, and rapid emaciation. The urethral discharge stops during the active joint disease. A chronic course is run in some cases, when it is most frequently a sequel of gleet. In the acute variety the liquid in the joint accumulates rapidly and is of a serous nature, containing fibrin, blood corpuscles, and pus cells in abundance. Roswell Park reports a case of acute gonorrhea in which the discharge ceased after about two weeks, to be followed shortly by swollen

knees, sepsis, a typhoid condition and death. At the autopsy pus was found in the sterno-clavicular articulation with erosion of bone, pus in other joints, enlarged mesenteric glands, etc. This appears to be the first case of its kind on record. He was not certain that it was the patient's first attack of gonorrhea, and was not acquainted with the condition of the deep urethra before the attack. Klippel, in reporting two cases of this nature affecting the sterno-clavicular articulation calls attention to the fact that associated muscular atrophy was of the pectoralis major. Cheminade finds that while ordinary blenorrhagic arthritis is very rare in women, it is unattended with fever, the general symptoms are not well marked, and the knee is generally the joint affected. Yet there is occasionally met with in women an arthritis of such origin in which the general symptoms are severe, the fever high, and the wrist and elbow the ordinary seats.

The **treatment** for all of these varieties of gonorrheal joint affections is early aspiration and irrigation of the joint cavity with bichloride solutions, followed by an injection of iodoform emulsion which is allowed to remain in the joint. If after a few treatments of this kind fever does not disappear and local symptoms do not improve an arthrotomy should be done, and the operator should have no hesitation in freely opening the joint where there is much pain and other grave symptoms, since the longer these cases are permitted to go without operative interference, the more likely there is to be ankylosis. If the operation is successful the pain should rapidly disappear, the temperature fall and the general condition improve. Early operation will prevent, rather than increase, the danger of ankylosis.

If the surgeon is satisfied that the joint surfaces have been destroyed the member should be placed in a normal position and mobilized with plaster-of-Paris. Lassalle strongly advocates arthrotomy in all forms of blenorrhagic arthritis, and states that the method is especially applicable where there is much pain and distension.

The practice of *brisment force* before all active symptoms subside is inadvisable, since it is not infrequently followed by a renewed attack.

The following cases are reported to more thoroughly elucidate this grave and most troublesome condition.

CASE 20. J. T., aged thirty-five, was attacked with acute synovitis of the right knee joint about three weeks after he had contracted a gonorrhea which followed dissipation and exposure. The joint was greatly distended, red and swollen, pain very severe, elevation of temperature, frequent pulse, and loss of appetite; emaciation and atrophy of the muscles of the thigh and leg rapidly succeeded. The knee joint was aspirated and about six ounces of synovia, mixed with pus cells and shreds of fibrin, were removed. This was followed by irrigation of the joint with a solution of bichloride. Local application was made to the joint with a solution of equal parts of glycerine, tincture of iodine, laudanum and fluid extract of belladonna, applied on a sponge and held in position by oiled silk and a bandage. Buck's extension was applied until an elastic traction brace was made and applied, after which symptoms began to abate. During the course of the inflammatory process it was necessary to aspirate the joint five times, which was always followed by an injection. The case made a complete recovery in three months. It was followed by limited motion, but no bony ankylosis.

CASE 21. A., aged forty-three, a farmer, had an attack of malarial fever (?), which lasted about ten days. He made a good recovery, but the first day he was out he walked quite a distance and the second day he over-exerted himself and was caught in a rainstorm and thoroughly drenched. He again

went to bed with symptoms of a relapse of his malarial fever, but after he was in bed three or four days his right knee became painful and swollen. This condition became rapidly worse, until a typical synovitis of the right knee joint developed. For some days after the trouble began, the pain was unendurable, except under morphine. An effort was made to treat the trouble by use of liniments, etc., but the pain and distension of the joint both increased. An extension brace was applied and the pain was to a great extent relieved. This patient was very intelligent, and used the elastics perfectly, and was able to so adjust the traction as to secure wonderful relief.

FIG. 79.

SHOWING BRACE ON, AND THE KNEE AFTER TREATMENT IN CASE 21, ALSO BRACE ON A SHOULDER CASE.

This case was aspirated eighteen times and thirty ounces of pus removed from synovial cavity. Ten injections of a solution ten per cent. iodoformized glycerine was made into and around joint during the course of the trouble. The symptoms for a

time were grave and the high fever and extreme emaciation made it a serious question as to the advisability of an open operation, but the patient began to show some signs of improvement, and in three months after the onset of the trouble the active symptoms had subsided and the brace was laid aside for a plaster-of-Paris splint. He discarded the plaster-of-Paris in two months and the knee was practically well. The patient had an acute specific urethritis at the time of the onset of the trouble; the discharge ceased, however, during the synovitis, but returned as a gleet after the knee symptoms had subsided.

CASE 22. L. H., aged thirty, railroad fireman, had acute synovitis of the wrist joint, associated with specific urethritis. Case was very severe, associated with all of the symptoms of acute disease, vis., pain, swelling, slight redness, doughy condition of the soft parts, with atrophy of the muscles of the forearm, temperature and marked emaciation. Under aspiration, irrigation, injection of iodoform emulsion, and elastic traction, the patient made a very good recovery with slight ankylosis, after being off duty for five months. He is now pursuing his former occupation.

CASE 23. V. D. P., aged twenty-six, railroad conductor, sprained his ankle by getting off his train, which was followed by a very active synovitis of this joint, with the usual symptoms. He had gonorrhea at the time of the injury but the discharge ceased at the beginning of the synovitis. Patient was given internal treatment of iodide and mercury with local applications of stimulating liniments with elastic traction, but no operation was performed. After a course of about six months he was able to return to work.

INTERNAL DERANGEMENTS AND DISEASES OF JOINTS.

**Dislocated cartilages** and other derangements of joints, especially of the knee, present a class of cases most troublesome to treat by the ordinary means since they are not considered sufficiently grave to demand operative inferences, and are too frequently considered sprains. The patient thinks that the bone is "out," and the doctor classes it in that variety of cases which

do not warrant an open operation, advises against such an occurrence, and tells the patient to make up his mind to grin and bear the torture. These troubles are anything from a slight dislocation of a semilunar cartilage of the knee joint to a complete displacement of this structure, or the folding in of the same between the heads of the bone, and other derangement, as an elongated ligamenta alaria, folding in of the joint sac or rupture of the same, loose cartilages, loose bodies, and villous or hypertrophied fringes.

Goodsir, states that the internal semilunar cartilage is an appendage of the internal head of the tibia, and the external semilunar cartilage moves backward and forward, in flexion and extension, with the external condyle of the femur, but these cartilages must be considered continuous with the head of the tibia, since they are attached firmly to it, by their cornua as well as anteriorly by the transverse ligament. They may be torn from their anterior or posterior attachment or from the coronary ligament. *Causes* are: falling with the knee bent under, or slipping with the toes turned outward, or any action which will severely twist the joint during flexion. Prolonged kneeling or strains on the anterior part of the coronary ligament, and lax conditions of the ligaments above the joint, especially, as Shaffer has pointed out, of the ligamentum patella, this fact being demonstrated by a series of skiagraphs, which showed that the patella rested well back upon the condyles when the knee was in right angle flexion.

Allingham classifies these derangements as acute and chronic, and bases the diagnosis upon the following symptons :—Directly after the cartilage is displaced there is often tenderness over the upper part

of the tibia. Flexion is not interfered with, and its exercise gives rise to no pain. The knee is fixed in a semiflexed position. There is inability to completely extend the limb. An attempt at forcible extension will probably cause pain over the tuberosities of the tibia—over the inner head, if the internal cartilage, over the outer head, if the external cartilage be affected. On extension a prominence will be produced, or a depression be felt, between the femur and tibia on the inner or outer side of the ligamentum patella. Forced extension may cause acute pain, the sensation being as if something was jammed between the femur and tibia. Patients sometimes compare the joint to a hampered lock, or to a gate with a stone in the hinge. Such a joint will move freely in one direction (flexion), but after having reached a particular point in the other direction (extension) its motion will be suddenly arrested. If, on examination, the knee is bent to its utmost, a crack or click may be heard, and the elevation on the inner or outer side of the joint may altogether disappear. This is due to the displaced cartilage, or portion of cartilage, slipping back into its normal position. On rising suddenly from a kneeling posture severe pain may be felt in the knee, and the patient be unable to straighten the limb. The same occurs when rising after a fall. When the accident has frequently occured, the knee gives way on walking, and great pain is suffered. Patients can generally walk on the injured leg, but with an obvious limp. Such a movement as walking up-stairs may cause the leg to slip and become fixed. Running is sometimes possible, but then only in a very awkward manner, for fear of the joint becoming fixed. The foot is generally

turned inward if the external cartilage be affected, and outward when the internal cartilage is deranged. There is usually little or nothing abnormal to be seen about the joint—i. e., no swelling or alteration in shape is visible.

**Treatment** consists in the reduction of the dislocated cartilage when seen at a time when the leg is locked. This is best done by allowing the patient to sit on a table, and grasp the leg and flex it as far as possible, so as to separate the anterior surfaces, rotate the tibia inward, if of the internal cartilage, and outward, if of the external cartilage; then extend the leg quickly but gently, and at the same time hold the cartilage in with the thumb. Individual cases, however, require special manipulation, as has been pointed out by Mr. Hey, Mr. Holmes, Sir Astley Cooper, Sir Wm. Ferguson and others. The retentive or after treatment, as has been wisely pointed out by Shaffer, is to wear continously for several months a Campbell brace, which when properly adjusted prevents all rotary-lateral movements, but permits flexion and extension.

In chronic cases where there is a permanent dislocation of the cartilage, or when the cartilage has been lacerated, or curls up into the condyloidal notch, and in cases where there is pedunculated projections from the margin the of cartilage, the proper method of treatment is to enter the joint, remove such abnormal conditions as may be found, return the cartilage to its original position and secure it with catgut sutures.

## LOOSE BODIES IN JOINTS.

**Loose bodies in joints** are of all sizes, from a pea to a horse chestnut; are single or may be many; are

loose, or they may have a pedicle, and vary greatly as to shape.

Three *varieties* are recognized, viz.: fibroma, lipoma and chondroma.

The *causes* in some cases cannot be traced but they may result from synovitis. Traumatism may result in fracture and casting off of a piece of cartilage. They may develope from an old blood clot and may follow any of the various inflammatory diseases of the joint. They are most frequently found in the knee, next in the elbow, but may develope in any joint.

As to their origin, Pooly may be quoted as follows: "(1) As villous outgrowths from the synovial membrane which are more and more crowded off from the surface, containing cartilage cells growing and after a time often ossifying in the center; (2) from detached osteophytes of osteo-arthritis; (3) from outgrowths from the articular cartilage; (4) from detached pieces of cartilage with or without a bony substratum, which have been separated by sudden violence or a quiet process of necrosis; (5) from blood clots in the cavity itself, or more probably from synovial villi; (6) from fibrin poured out in an acute inflammation, or in a rheumatic subject in a limited space under the synovial membrane, which it pushes forward until pedunculation, and later complete separation, of the nodule takes place; (7) from outgrowths of cartilage cells normally contained in the synovial membrane; (8) from detached tuberculized fringes. The first mode of origin is the most common, the others being rare."

The so-called rice bodies, or *corpora oryzoidea*, are the result of peduncular growths from the synovial membrane.

The **treatment** consists of an open incision into the joint and removal. They are very difficult to get out and may disappear as soon as the joint cavity is entered. To insure their removal, if the body or bodies are of any size they should be transfixed by a needle just before the synovial sac is punctured. Strict antisepsis should be observed, and except for specific reasons no operation should be done outside of a hospital. If the wound heals without infection the knee should recover perfectly, but when infection takes place amputation is not an unusual sequel.

Results of operation in 576 cases show 78.8 per cent. cures, 10 per cent. failures and 12 per cent. deaths.

### CHONDRITIS.

**Chondritis** is an inflammation of cartilage, and seldom occurs as a primary condition except in the semilunar cartilages of the knee joint. Cartilage is a low grade nonvascular tissue, without nervous supply, deriving its nutrition from contiguous bone and synovial structures.

The **pathological** changes which occur are rapid multiplication of cells with increase of number of nuclei, followed by ulceration, fibrillation, development of granular tissue and sloughing off of portions of cartilage which remain as loose bodies in the joint. As the bone is denuded it breaks down and may become extensively involved. As resolution takes place plastic adhesions, or ossification occur, resulting in ankylosis true or false. Three varieties are recognized, viz.: hypertrophic, atrophic and fungoid.

The **causes** are the same as those producing synovitis when it occurs as a primary condition. In modern days of athleticism we find a knee which has been call-

ed "Football Knee." It is an inflammation or dislocation of the semilunar cartilage due to the violent exercise the knee is subjected to while playing the game.

**Treatment** consisting of blistering and absolute rest for some weeks, with an immobilizing apparatus to be worn for some months longer, generally results in a cure.

ANKYLOSIS.

**Ankylosis**, or *arthrosclerosis*, is a term used to designate an interference with the normal range of motion of a joint as a result of structural change in the joint.

FIG. 80.

FIG. 81.

Ankylosis may result from (1) tubercular bone and joint disease; (2) suppurative joint disease as from gonorrhea, syphilis, sepsis from operations and accidents; (3) rheumatoid arthritis or arthritis deformans; (4) arthritis plastique ankylosant; (5)

fractures into the joint; (6) cicatrices from burns, and such destruction of tissues external to the joint as may follow infantile spinal paralysis. A series of experiments were carried out by Dr. Phelps upon dogs to determine what produced ankylosis. The legs of some of these dogs were locked up in plaster-of-Paris for months. Dr. Phelps also made a somewhat extensive investigation of the methods of treatment of fracture and injuries into joints, and in conclusion makes the following statement:

"1. That a normal joint will not become ankylosed by simply immobilizing it for five months.

2. That motion is not necessary to preserve the normal histological character of a joint.

3. That when a healthy joint becomes ankylosed or its normal histological character changed, it is not due to prolonged rest, but to pathological causes.

4. That immobilizing a joint in such a manner as to produce and continue intra-articular pressure will result in destruction of the head of the bone and the socket against which it presses.

5. That atrophy of the muscles of the limb will follow prolonged immobilization of a joint. The question of ankylosis is determined by the severity of the inflammation, the presence of intra-articular pressure, the subsequent cicatricial contraction of soft parts around the joints, the tissues involved and the amount of destruction of bone and cartilage."

**Varieties.** Ankylosis is known as *true* when there is complete ossification of one bone entering into the formation of a joint to the other; and *false* when bony union does not exist, but where a fibrinous or ligamentous band forms the bond of union. Cases of hip

disease are treated with the long traction splint, which locks the knee up, from one to three years, and in a month after the knee is liberated motion in the joint is perfect.

**Passive motion**, as recommended in text books and practiced by so many, does more harm than good. *Brisment force* should be the practice rather than passive motion. Joints which are undergoing pathological changes must necessarily have these changes increased by constant or even daily movements. Instead of the joint being permitted to remain quiet and the process of repair go on uninterrupted, it is aggravated. Ankylosis is the result of prolonged inflammation and not of immobilization.

**Brisment force** occasionally results in as great ankylosis as before operation, or even greater. This should not, however, argue against its practice since brilliant results are achieved.

Passive motion should not be practiced until all inflammation has subsided, neither should *brisment force* be done even in the most chronic variety of joint disease until every symptom of the disease has disappeared. Especially should this be the practice in gonorrheal synovitis.

When there is considerable angular deformity, and *brisment force* and continued leverage with massage has been practiced without success, some cutting operation will be necessary.

The practice of *brisment force* for ankylosis depends upon the cause of the trouble. In rheumatoid arthritis, or where more than one joint is involved, caution should be used. An occasional old case, however,

which has been still for years, will yield to treatment and a perfect joint is the result.

**The hot air** treatment of ankylosis is undergoing the experimental period. Papers by Wirt, of Cleveland, Balakovsky, of Russia, Sibley, of London, Frazier of Philadelphia, and Gibney, of New York, contain valuable suggestions as to its merits. Gibney reports four cases, and Frazier reports in detail the results in twenty-five cases. The physiological effects according to Frazier (*Annals of Surgery*, Oct. '97) are that the temperature is elevated, and pulse and respiration accelerated. The blood pressure of the parts included in the bath is increased and bodily weight is reduced. His conclusions are that little benefit may be expected

FIG. 82.

BETZ APPARATUS.

in acute tubercular or gonorrheal diseases, but wonderful results are obtained in cases of traumatic ankylosis, or as result of old synovitis and in rheumatic cases in all stages which do not yield to medical treatment. Fig. 82 shows the Betz dry hot air apparatus, the most economial and one of the best apparatus made.

The writer is using the hot air treatment in several

cases, and such marked improvement has taken place, as warrant its further use in old ankyloses with no active symptoms.

The pain in a tubercular shoulder was entirely relieved by hot air after two weeks treatment.

SUBLUXATION.

**Subluxation.** In order that the treatment of subluxation of the knee joint may be properly carried out its cause must be understood.

Subluxation of this joint is an under dislocation of the head of the tibia back of, or posterior to the condyles of the femur. Such a deformity does not exist as a result of chronic disease when the femur is kept parallel with the tibia during the various stages in tubercular, traumatic, gonorrheal, and other inflammatory diseases in and about the knee joint. It can only result from direct violence and from faulty position during the course of treatment of acute and chronic diseases of the joint.

A series of experiments have been carried out to determine the relative power of the flexor and extensor muscles of the leg, as well as to determine at what angle in flexion the flexor muscles equaled the extensors in power. We must remember that extension of the leg is limited to a parallel line with the thigh, and that flexion is only limited by the resistance of the calf by actual contact with the thigh, or through an arc of 90 degrees. In extension the flexors and extensors are antagonists, and oppose each other with equal advantage so far as the position of the bones themselves are concerned, because they both have direct action. The advantage is here given the extensors from the fact that they are always more powerful than the flexors.

As the leg is flexed the extensors lose their original power of direct action and act over a pulley, or in more inelegant language, around a corner. This pulley is formed by the action of the quadriceps extensor femoris, patella and ligamentum patella over the condyles of the femur. As the leg is flexed, the extensors lose power, and the flexors gain. In order to determine the power of these sets of muscles, and to more particularly determine at what angle of flexion the flexors equaled the extensors, experiments have been made. It is quite customary to treat diseased conditions of the knee joint in flexion ; the degree of flexion being determined by the attendant. Some reasons given for this are that it places the leg in a better position for use during after years, or it is more comfortable to the patient, etc., etc. All the reasons given are fallacious, and founded upon anything but sound reasoning. In the case of traumatic and other forms of synovitis it is probably true that a greater area of joint surface is included between the heads of the bone and semilunar cartilage in extreme extension, than in slight flexion when only the position of the articulating surfaces of the condyles would press against a corresponding surface of the semilunar cartilage. Such a reduction in actual surface pressed upon could not diminish the pressure, but would place the leg in a less secure position, and thus increase muscular spasm and a resultant increase of interarticular pressure. It must be remembered that all muscles which pass over, or tendons of which pass over, or control the action of a joint in inflammation, is in a state of spasmodic contraction. This increased action on the part of the muscles is an effort on the part of nature to protect the sensitive joint. The deformity which follows,

is in the direction of the most powerful muscle or set of muscles. In hip joint disease it is flexion, adduction or abduction. In tarsal disease it is valgus, varus, flexion, extension, etc. In knee joint disease, it may remain normal as it generally does in diseases of the shoulder or wrist, so long as the leg is kept in a position favoring this. Just as soon, however, as the flexors have a greater power than the extensors, we have an increase of flexion. As a result of experiments an approximate estimate of the muscular power, showed that with flexion at an angle of 45 to 50 degrees, the flexors had absolute control of the leg. This will admit of two things : 1st, an increase of flexion, and 2nd, a tendency of the head of the tibia to glide further back under the condyles. This is not only correct theoretically, but is borne out clinically.

The writer has thus dwelt at length upon the cause of the condition under consideration in order that the treatment might be preventive, rather than to be called upon to correct the deformity after its existence. The treatment of subluxation may be summed up briefly as follows :—

It must first be determined whether true or false ankylosis exists ; whether the dislocation is partial or complete. In true ankylosis a complete section of the bone must be made, either by the use of chisels or saw; and if the relationship of the bones cannot be restored without it, a wedge shaped section should be made; the bones brought together, wired or otherwise secured. In cases of ligamentous or false ankylosis with a partial subluxation, *brisment force* with tenotomies of the hamstring tendons is generally sufficient.

The most difficult cases to manage are those where

the adhesions are more or less firm, and a complete luxation of the bones exists. Tenotomies of the tendons will free the lower portion of the head of the tibia, but great force does not, as a rule, restore the joint surfaces to a normal relationship. It is quite possible after tenotomy to bring the leg parallel with the thigh, but it will be found that the leg is upon a lower plane than the thigh.

This is due to the fact that the head of the tibia does not slip down and forward upon the condyles, but instead the relationship of these bones are not disturbed. The condition which exists is shown in Fig.

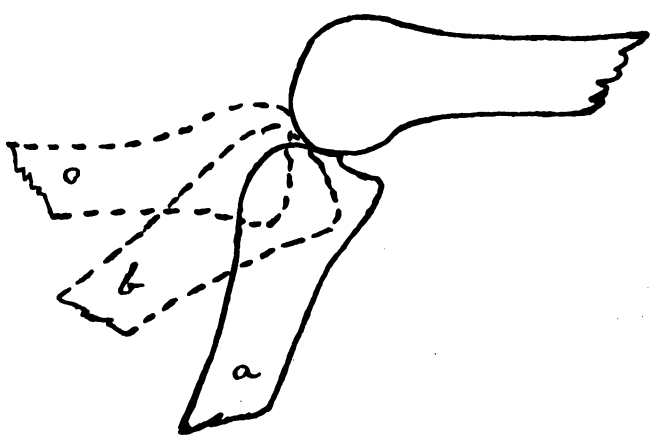



FIG. 83.

83, "a" representing the condition before correction, and "b" and "c" the condition as the bones are brought parallel, which, as may be observed, increases the pressure of the anterior surface of the tibia against the condyles of the femur, and thus prevent the head

of the tibia from gliding forward over the condyles of the femur.

Immediate reduction of subluxation of the knee joint is prevented: 1st, by the adherent patella and synovial membrane to the condyles; 2nd, by the impinging of the anterior portion of the head of the tibia against the condyles. In cases where the hamstrings are not cut, this burrowing in of the bones upon each other is much greater, and an immediate reduction is less likely to be effected. Gradual and continuous leverage offer the best means for correcting the deformity mechanically.

In this degree of deformity, a rapid cure cannot be promised except by a radical operation. By mechanics a complete c. rrection must not be attempted at the time of the practice of *brisment force*, but instead, the leg should be carried forward to an angle that would permit a gradual correction of the subluxation. If plaster-of-Paris is used as a support, it should be reapplied every 10 to 14 days. In Fig. 81 is shown a brace which serves the best in these cases as a correction as well as an immobilizing appliance in acute diseases and injuries about the joint, and is most effective in overcoming subluxation of the knee joint.

### TENO-SYNOVITIS.

**Teno-synovitis** differs little from synovitis of joints. The course is about the same. The soreness is along important tendons, and pain is increased as the muscle is brought into action. An occasional and not at all desirable result is adhesion of the tendon to the sac, resulting in an interference of the usual range of action of the muscle, and consequent impairment of the use-

fulness of the member. In old cases they should be forcibly stretched under an anesthetic. If this is not sufficient, an open operation may be done with profit. Care must be taken to avoid sepsis, for suppuration will result in greater adhesion and increase of deformity.

## GANGLION.

**Ganglion.** These tumefactions so frequently seen on the back of the wrist, especially of young people, are not associated with ill consequences and occasionally disappear without special treatment. If they are large they make the hand appear somewhat unsightly, and destroy the full power of the extensors of the finger, resulting in a slight disability of the hand.

**Treatment.** Usually tincture of iodine with a hard compress as a large button worn over the enlargement for some weeks, will in many cases effect a cure.

A sharp blow with a hard object, as the back of a book or the hand, upon the apex of the enlargement will rupture the sac and permit the fluid to escape into the surrounding cellular tissue from whence it is absorbed, and the parts are restored to a normal condition. The abnormal fluid not infrequently reaccumulates, in which event aspiration and injection will be required.

Jordan thinks the enlargement is due to a hernial protrusion of the synovial sac through a slit in the fascia between the tendons, and reports twenty-five cases of this condition which were treated by aspiration and injections of enough Morton's fluid to make partial distension of the sac, after which the parts are manipulated and dressed with a firm compress.

Enlarged bursae about the knee, especially the con-

dition known as "house maid's knee" require as an introductory course of treatment, local irritants, as iodine and pressure by pads worn continuously and for some weeks.

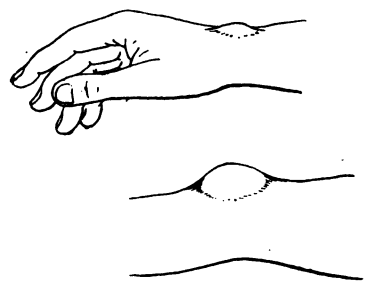


FIG. 84—GANGLION AND HOUSE MAIDS KNEE.

Hernial protrusions of synovial membrane occasionally occur and the tumor may become quite large. They seldom result in ill consequences, but are rather troublesome to cure. Roncali has operated on seven cases, six of which were completely successful. "One of these, a man aged 25, fell on his left knee in January, 1893. Eight days after this the knee became swollen, and remained so for five months, then entirely disappeared. In August of the same year he noticed a swelling in the popliteal space, which was rapidly increasing, causing a sense of weight and weakness in the limb, but no pain or fever. The popliteal artery could be felt beating over the tumor; the swelling was seen to be divided into an upper section, as large as an eight month's fetal head, and a lower about the size of an orange. Pressure on the tumor caused no diminution in its size or alteration in the form of the joints. An incision was made over the tumor, and the bursa,

with three crypts, firmly adherent to the posterior surface of the capsule of the joint, was removed. There was no communication with the joint. The patient was able to leave the hospital two months after, with perfect freedom of movement and completely cured."

# DEFORMITIES DUE TO LESIONS OF THE NERVOUS SYSTEM.

## SCOLIOSIS.

This affection, also called *lateral curvature* of the spine, is a rotary lateral deviation of the spinal column from its normal physiological direction and is associated with resultant deformity of the trunk.

It is the most frequent of orthopedic affections. In 15,292 orthopedic cases, 4,892 were scoliosis. In Prussia there are 65,000 cases, and on examination it was found that of 2,800 school children in Denmark, 363 had scoliosis.

*Age and Sex.* There are about five girls to one boy between the ages of 6 and 14, but in children under five years, boys and girls are equally affected. Of cases of exaggerated scoliosis, the number of males are in excess. Ninety-five per cent. of second stage cases occur before the tenth year, and 50 per cent. between the ages of 7 to 14, and but 35 per cent. after the age of 18. It may be congenital and is found in old age.

*Heredity* has to do with the production of lateral curvature from the fact that parents with weak constitutions, poorly developed muscular and osseous systems, with tendencies to neuroses, will have children with similar constitutions, and according to some authorities 27 per cent. of all cases have a hereditary history.

*Stages.* Three stages of the disease are recognized; 1st, initial stage; 2nd, stage of development; 3rd, stationary stage.

The first stage may be defined as that period from the earliest date of deformity to recognition by the

mother or dress maker. This is most frequently just before puberty. The second stage is from puberty, or from the time of recognition of deformity, to the end of the period of development, generally to the age of eighteen or twenty. The third stage is that of perfect development, and permanent deformity.

*Deformity.* The development of the deformity may be divided into three stages also; 1st, from the earliest date of deformity to the time that the deformity can be perfectly corrected by suspension; 2nd, from the time when the spine cannot be corrected to ankylosis, and 3rd, the stage of ankylosis, or when the spine is fixed and no correction can be made by manipulation or suspension. The primary curve is always the greater curve, usually found in the dorsal region, and the secondary curve is the lesser curve found on the opposite side of the median line from the primary curve. It is generally in the lumbar region.

Six different forms of curvature are recognized: (Young)

"1st. Primary right dorsal curve.
2nd. Primary left dorsal curve.
3rd. Primary left lumbar curve.
4th. Primary right lumbar curve.
5th. Primary right convex total scoliosis.
6th. Primary left convex total scoliosis."

The primary curve is the first and greatest curve and is named above in order of frequency, about 56 per cent, of all cases being of the first variety. In all curvatures with a marked primary curve of the first variety the secondary curve will be in the lumbar region and in an opposite direction. A tertiary curve is occasionally found in the cervical region, made manifest

by the position of the head. In scoliosis the deformity is not only to one side of the median line, but there is also a backward or forward curve. As a rule the backward curve, or kyphose, is the primary curve and a forward curve is found associated with the secondary curve in the lumbar region, producing lordosis. This latter condition is only found in very marked cases. The primary curve describes the arc of a circle and not an acute angle. Very rarely the primary curve may be a lordosis and the secondary curve be found in the dorsal region, in the form of a marked stoop shoulder, in which condition the curvature would be antero-posterior. Deformity of the ribs will be found. The trunk in front on the sides of the primary deformity will be flat, while the other side of the mammary line will be prominent.

*Torsion* of the spine is as a rule found, for it is rare that we find an antero-posterior scoliosis. This twisting of the spinal column is caused by the bodies gliding laterally upon each other, while the fixed point is at, or posterior to, the articulating facets. Judson says: "It seems to me that rotation takes place because the anterior part of the column, the bodies, are free to move laterally in the cavity of the chest and abdomen, while the posterior part of the column, the processes, are prevented from the same degree of lateral displacement by being entangled in posterior parietes, composed of ribs, muscles and fascia."

Limping is present in a certain percentage of cases, and is due to the distorted spine tilting the pelvis, and thus producing apparent shortening of the leg, but an inspection of the spine and measurement of the extremities will eliminate suspicion of diseases of the hip. or

leg. On the other hand scoliosis may be produced by unequal length of the legs.

*Etiologically*, scoliosis may be divided into (*a*) congenital, (*b*) habitual, (*c*) static, (*d*) pathological, and (*e*) traumatic.

(*a*) Congenital deformity is supposed to be due to some perversion of development of the nervous, muscular, or osseous systems during embryonic life, or to malposition in utero.

(*b*) Habitual scoliosis includes all those cases resulting from faulty position at school, at work, lack of attention to the development of the body, carelessness in habits, confinement in factories, or retarded ossification, taken in consideration with a weak muscular system and the superincumbent weight of the head and arms. Mothers and nurses produce scoliosis in babies by holding them in a faulty position, and young girls who are required to "carry the baby" tilt their spine to one side and produce scoliosis. School desks improperly made, together with the rules of the school requiring pupils to twist the body to one side while writing, constitute a fruitful source of this deformity.

(*c*) Static scoliosis is that variety due to an unequal length of the legs as is found in hip, knee and other bone diseases, fractures with shortening and paralyses resulting in shortening.

(*d*) Pathological scoliosis includes all lateral curvatures of the spine, resulting from rickets, empyema, atalectasis, torticollis, cicatrices from burns, necrosis of the ribs and sternum, rheumatism, arthritis deformans, muscular atrophy from paralyses, etc. In collapse of the lung following consolidation and resolution, or in abscess of the lung followed by a cure, lateral curvature

is generally found, but a study of the history of these cases will determine the cause and outline the treatment.

(*e*) Traumatic scoliosis is not frequent and would include such cases as result from injuries, or fractures sufficiently severe to distort the spine.

Theories as to the *causes* of scoliosis within the body are: 1st, (nervous) paralysis; 2nd, (muscular) contraction of muscles on one side of the body, as torticollis is produced; 3rd, (osseous) softening of the vertebral body and intervertebral disks. In all cases of lateral curvature the superincumbent weight of the head, shoulders and upper extremities is the force above the seat of distortion which produces it. Lateral curvature is found in weak and anemic girls, when no other apparent cause is to be found. It is also true that great anemia and muscular weakness does not, as a rule, result in scoliosis. The experiments of Judson, and Bradford and Lovett, relative to the manner in which distortion takes place, are interesting and may be studied with profit.

The **pathological** changes which occur in scoliosis are alteration of the relationship of the bodies of the vertebræ to the articular and spinous processes. The bones of the trunk in severe cases are also altered. There is also found an elongation of the spinal ligaments on the convex side, and shortening on the concave side, and a lack of tone of the deep erector spinae muscles. The muscles on the concave side are shortened while those on the convex side are longer. The superficial layers of thoracic muscles are found so changed in length as to conform to the deformity. The intervertebral disks are twisted as the bones are turned to one side.

The unequal pressure makes them wedge-shaped with the base toward the convexity of the spinal curve. Growing bones adapt themselves to the torsion and curvature, and in time become permanently deformed. The spinal, thoracic, and pelvic deformity results in displacement of the thoracic, abdominal and pelvic viscera, the variety and degree of displacement depending on the severity of the deformity. To the symptoms of deformity, paralysis, and ankylosis already enumerated, there may be added some pain, although this is not always found, dyspnea, emphysema, catarrhal bronchitis, phthisis and palpitation of the heart. In some cases there is great discomfort, while on the other hand very marked deformity, where there is a gradual onset, may exist and the patient suffer little inconvenience.

**Diagnosis** of scoliosis is not difficult at any stage, except in its early development. Slight elevation of one shoulder, with lack of symmetry of the two sides of the body, is first noticed, possibly by the dressmaker or the mother, and little attention is paid to it. If the family physician is consulted he says the child will come all right. But it does not, and the curvature grows progressively worse. A critical *examination of* the nude body must be made. It must be inspected from all aspects, and a comparison of the two sides made. Measurements from the anterior and posterior median line, on one side, and then on the other, are of value. Of the various means of making examinations and keeping record of cases the one in most common use is that of a lead tape or lead wire, by means of which an exact outline of the spine or of the thorax can be made and transferred to case-record paper.

FIG. 85.—FRONT AND BACK VIEW OF SCOLIOSIS IN SECOND STAGE.

These tracings taken from time to time can be compared and an estimate made of the changes. Screens with meshes of definite size are used to record deformity. Expensive apparatus, have been constructed but are used only by the inventor in whose hands they are of value.

Weigle, of Rochester, gives us a method of recording the curvature which in skilled hands would be quite accurate. The patient must be placed exactly in the same position, or accuracy will not be had. The apparatus consists in an upright rod which slides along a stationary board on which is tracing paper. The lower end of the rod is tipped with a wheel which travels across the body, as it is moved back and forth, and a pencil on the rod makes a tracing on the paper on the board. Kermisson objects to recording apparatus which are to be used during recumbency, claiming that records are not so accurate as those taken in the erect posture. Saunton describes various apparatus used for recording deformities of lateral curvature.

**Differential diagnosis** must be made from Pott's disease, infantile spinal paralysis and lung diseases resulting in destruction of the lung tissues

DEFFERENTIATION.

| *Scoliosis* | *Spondylitis.* |
|---|---|
| **Scoliosis is a permanent lateral deviation of the spinal column, or part of it from the natural physiological direction.** | Spondylitis is a tubercular disease of the vertebral bodies or inter-vertebral disks leading to their partial or complete destruction. |
| SYNONYMS. | |
| **Lateral curvature;**<br>**Lateral distortion;**<br>**Deviation laterale de la taille.** | Pott's disease;<br>Vertebral tuberculosis;<br>Antero-posterior curvature;<br>Angular curvature;<br>Kyphosis (Greek);<br>Mal da Pott (French);<br>Spitzbuckel (German). |

| | |
|---|---|
| ETIOLOGY. | |
| Heredity has little to do with it. | Tubercular history in 90 per cent. of cases. Slight injury from a fall. |
| SYMPTOMS. | |
| A—No constitutional disturbance; | A—Malaise; |
| B—Spine not rigid in 1st and 2d stages; ankylosis in 3d stage; | B—Rigidity of spine at all times; |
| C—Rest good at night; | C—Night-cries; |
| D—Seldom pain; | D—Pain of nerve terminals over thorax or abdomen; |
| E—Muscular weakness may be present; | E—Cervical disease, head in wry-neck; |
| F—Asymmetry; first noticed by dressmaker or tailor; | F—In cervical—hands under chin; |
| G—Generally primary; right dorsal curve; | G—In upper dorsal—chin and shoulders up, neck forward; |
| H—Secondary curve toward left; | H—In dorso-lumbar, hands on knee; |
| | I—In lumbar—abdomen forward; shoulders back; |
| J—No fever; | J—Generally some fever; |
| K—Digestion good; | K—Indigestion and intestinal irritation; |
| | L—Cachexia; |
| M—No bone destruction; | M—Destruction of bone; |
| N—Angle oval. | N—Angle acute. |
| STAGES. | |
| 1st—Initial. | 1st—Initial. |
| 2d—Stage of development. | 2d—Destruction and abscess. |
| 3d—Stage of arrest. | 3d—Resolution or reproduction. |
| TREATMENT. | |
| A—Tonics; | A—Tonics; |
| B—Exercise for muscles of spine; | B—Immobilize the spine; |

C—Remove superincumbent weight;
D—Self-suspension;
E—Suspension without limit;
F—Racheocampsis, or forcible breaking up of ankylosis of the spine.

C—Remove the superincumbent weight;
D—Suspension must be mild;
E—Care should be taken not to subject the spine to great violence, but overcome the deformity by continuous leverage.

MECHANICAL SUPPORTS.

A—Plaster-of-Paris applied during extreme suspension and forceable correction, to encourage ankylosis;
B—Author's brace;
C—Braces with serpentine elastic webbing.

A—Plaster-of-Paris applied during moderate suspension.
B—Taylor's brace;
C—Head support for disease above the seventh dorsal vertebra.

The **prognosis** depends upon the time at which the disease is discovered and placed upon proper treatment. The three stages of deformity must be studied and differentiated if an intelligent promise is to be made to the friends of the child of the ultimate outcome. In the first stage, or before permanent deformity exists, great promise of permanent cure can be made. In the second stage, or during permanent deformity, and while the spine is yet flexible, complete and permanent recovery may be promised in a majority of cases. If the case is in the third stage, or complete ankylosis, no promise can be made. These cases, as a rule, are hopelessly incurable. We have seen cases in the first stage given the best treatment, go from bad to worse to the third stage. In these cases it is difficult to explain why in spite of the best treatment no improvement can be made. The cause must also be considered if a correct prognosis is to be made. In cases where the cause can be removed or corrected, improvement is more likely to occur.

To *prevent* deformity is to develope a race of hardy people, to encourage athleticism at schools, colleges and at home, and to order exercises for all poorly developed children who may come under our observation. Systems of exercises. instituted for the purpose of developing muscles used in schools and in private institutions are numerous. It is not so much the variety of exercise as the amount and the intelligence with which it is carried out, which makes people strong. No system of exercise will develope muscles which falls short of fatigue, or which stops short of tolerance and repeated as often as permissable, usually daily. The position scholars are required to take at illy devised desks while writing is a cause which should be removed if scoliosis is to be prevented.

The **treatment** of scoliosis may be sub-divided as follows :

1st. To prevent progression of deformity.

2nd. To correct existing deformity.

3rd. To maintain the correction.

The means applied to accomplish these ends may be presented in the following order :

1st. Hygienic and medical.

2nd. Gymnastics to develope muscles.

3th. Correction, with the hands, braces and force machines.

4th. Retentive.

1st. Hygienic conditions of the patient must be improved. Outdoor exercises ordered consisting of sports, games, and bicycle riding in patients who are old enough to enter into these exercises. The general condition of the system must be improved by the use of tonics and digestives.

2nd. Gymnastics must be considered of the greatest importance during the first stage, and highly essential along with correctives during the second stage. Every orthopedic surgeon has his own system of gymnastics, carrying out a routine which appears most satisfactory to him.

Gymnastics may be voluntary or involuntary, the former consisting of such exercises as the patient freely enters into himself, and the latter, or forced exercise, by machines or by the orthopedic surgeon. After having used the various methods which have been published, modifying them to suit individual cases, some form of rubber exerciser for daily practice is superior to all other methods. In addition to this, forced exercise should be instituted by the surgeon twice or three times per week. The aim should be to develope the muscles which appear to be weakest. Courses of exercises have been outlined by Sayre, Teschner and others, but routine, it appears to me, is not advisable. Muscles can only be developed by persistent and, indeed, hourly practice. This practice should be carried to the point of fatigue, through the stage of soreness. This can be overdone but such a thing rarely occurs. *Self suspension*, as recommended by Dr. Benjamin Lee, which removes the superincumbent weight for the time and draws the spinal column straight, should be practiced twice or three times per week, or daily if possible. This is done by ordinary suspension apparatus and a pulley from the ceiling. One end of the rope is attached to the adjusted suspension apparatus, the other is drawn down by the patient. In this way the feet can be drawn from the floor. This may be repeated many times.

GYMNASTICS FOR LATERAL CURVATURE.

1. On stool—keynote—back and forth.
2. On stool—keynote—side to side.
3. On table—face down—circle legs to right.
4. On table—face down—circle legs to left.
5. Swinging over end of table, hands on heels, patient raises body in keynote.
6. Hands back of head, swinging body (surgeon holding feet).
7. One hand back of head, other over hip (surgeon holding feet), rise three to ten times.
8. One hand back of head, other over hip (surgeon holding feet), reversing position of hands.
9. On back—circle arms.
10. On back—circle legs.
11. On back—stick in hands, patient resisting.
12. On back—stick in hands, surgeon resisting.
13. Patients legs over end of table, hands support knees, patient raises body in keynote position.
14. Arms over convexity, patient standing, keynote swinging back and forth.
15. Lying on table, greatest curve over edge of padded table, or a pillow, forcible correction to crackling.
16. Forcible correction with hands or arms.
17. Forcible correction with Weigle, or other scoliosis apparatus.

The above are exercises carried out ordinarily, and are to be varied as the operator may direct.

Zander's method of mechanico-therapeutics is the most scientific and complete method now known. The system aims to improve the general health by active mechanics, passive mechanics, and a combination of the two.

3rd. *Correction* of the deformity is made by the use of the hands and arms, or by machinery. When ankylosis is not to extensive, the arms and hands of the operator is generally sufficient to produce correction. Correction by pressing the prominence over straps, rolls and swinging pads, is a valuable adjuvant, and should be used. The correction brace of

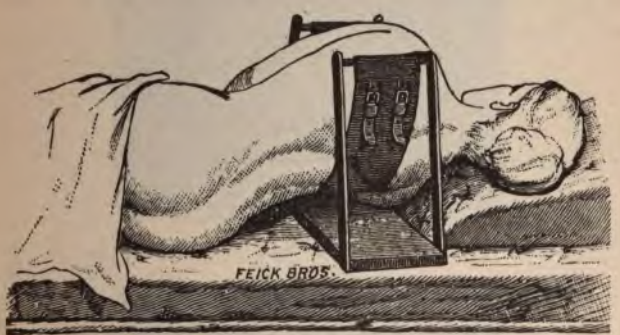



FIG. 86.

SWINGING PAD TO BE USED DURING RECUMBENCY.

Shaffer is of value. The brace shown in Figs. 87-88, as used by the author, has served well in the treatment of these cases.

*Recumbency* is the only effectual method of removing superincumbent weight. Mild cases are cured by assuming proper position while in bed. No pillow should be used and the bed should be flat and unyielding. The patient should lie straight and in such a position as to make pressure upon the prominence.

*Posture* includes the training of the patient how to walk and sit erect, and proper methods of breathing.

FIG. 87.

FIG. 88.

FIG. 89.

FIG. 90.

For forcible correction, or *rachiocampsis*, the appliances of Bradford, Bracket, Weigle and Schede, all make correction in the same way, i. e., by screw power. After suspension, the pelvis is fixed, which makes the first point of pressure. The second point is against the anterior surface of the thorax and shoulder, on the side where thoracic flatness is found. The third point of pressure is over the prominence of the primary curve, which is usually found along the external border of the scapula. The screws are tipped with strong plates well padded. Force up to the tolerance of the patient is now made by the screws, which must be applied very gradually and the condition of the patient studied in order that harm may not be done.

A correcting apparatus as used by the author is shown in Fig. 91. The principles used in the application of pressure are practically the same as those used in other machines. It recommends itself because it is inexpensive and occupies very little space in an office. It is quite effective, since as much pressure can be applied as may be borne by the patient or desired by the surgeon. It is folded against the wall when not in use.

4th. Correction is maintained : 1st., by the muscles which have been developed by gymnastics and by an improvement in the general health of the patient; 2nd. by braces which make pressure upon the prominences and do not interfere with the movements of the body or restrict the chest.

In no case, and at no time, should plaster-of-Paris or other rigid corsets be used unless it is desirable to encourage ankylosis of the spine. Muscles cannot be developed if they are held in rigid encasement all the time.

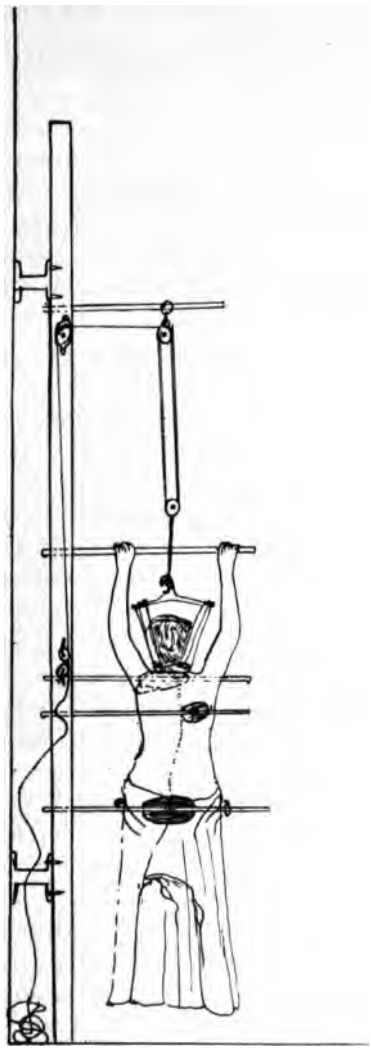


FIG. 91.

ORIGINAL DEVICE FOR FORCIBLE CORRECTION.

Bradford and Bracket have practiced forcible replacement of the deformity and apply a plaster-of-Paris jacket while the patient is in the correcting machine. Cases are reported by them and Goldthwait which show marked improvement of the deformity. Hoffa gives us an appliance to be worn by the patient constantly, which has as its principle feature, a support extending from the pelvis to the head. It is based upon correct and commendable principles.

The indications for correction as appear are: (1) produce pressure where it is needed, (2) not constrict the chest, and (3) give the thorax almost entire liberty at all times. The brace as used by the author is constructed as follows:

1. A broad and neatly fitting pelvic band.

2. An upright along the center of the spine, terminating above in two pads, one pressing upon the prominence of the curve over the inferior angle of the scapula, and the other higher up on the opposite side over the apex of the axilla.

3. Two wire uprights passing up in front, and terminating in pads the size of a silver dollar, one pressing against the shoulder, which is always tilted forward, and the other pressing upon the clavicle and first rib of the opposite side. These wires stand out from the body as they pass up They are held together above by a broad piece of inelastic webbing. The two pads on either side are held together by soft axillary bands.

4. A broad elastic band passing from the posterior upright around over the primary curve and buckled to the upright wire on the same side in front.

The brace, as will be seen, makes pressure on three points, viz.: at the pelvis, under one arm, and over the

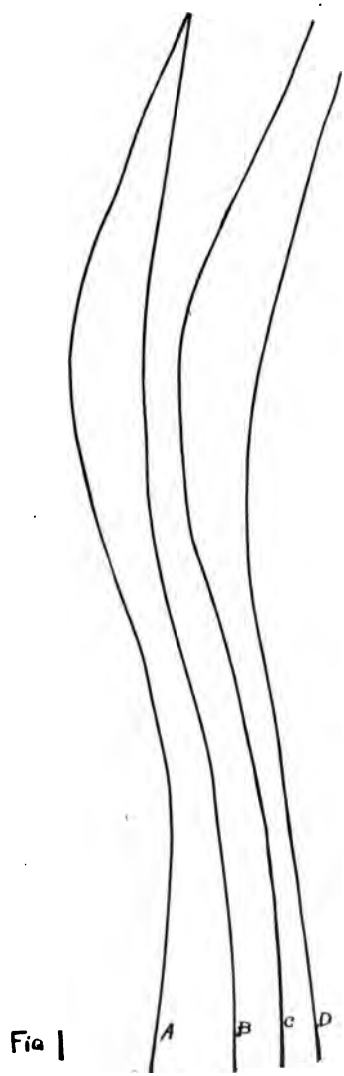



FIG. 92.

primary curve. No pressure is made in the concavities of the thorax or upon important muscles to encourage atrophy. The ordinary lateral movements of the chest are not restricted, and no pressure is made upon the erector spinae, or abdominal muscles.

The brace is intended as a corrective as well as a retaining appliance. The treatment by braces is the smallest portion of what is necessary to insure a cure.

CASE 24, P. S., girl aged 5 years, has had lateral curvature for about three years, resulting from whooping-cough. In this case the primary curve is toward the left, which is quite unusual. The case was under observation for about eighteen months. For about six months, treatment was continued once per week, with an improvement as shown in tracings, Fig. 92, A and B. From this time on the patient wore a brace of the old style and had some home gymnastics. Nine months later, the spine was as bad as when first seen, or as is shown in C. It was seen twice daily for twelve days, and correction as shown in D was made; the patient does not live in this city and she was taken home by her parents. Under treatment a complete correction could almost certainly be promised.

CASE 25, A. G., aged 9, with deformity as shown in Fig. 89.

She had been wearing one of the old form of *chest constrictors* and her deformity was growing worse.

Treatment was given this patient on Friday and Saturday of each week for three months, and the improvement obtained is shown in Fig. 90. Figs. 87 and 88 show the brace used in this case as applied.

## TORTICOLLIS.

**Torticollis**, also called wry-neck, is a lateral turning of the head toward the shoulder, due to contraction of the sterno-mastoid, or other muscles.

**Frequency.** It occurs more frequently in females than males, and is more likely to be found on the right side.

**Varieties.** (Tubby).

"First. *False*, arising from the spinal caries or cicatrices of the skin and fascia.

Second. *True*, { (a) Acute, Rheumatic. (b) Chronic, { Congenital / Acquired (spasmodic"

False torticollis is dependent upon other diseases, or may be considered a symptom of other conditions, remote from the usual causes.

True acute torticollis, commonly known as stiff-neck, requires no consideration here.

The *congenital* variety is always chronic and is a rare deformity. It is caused by injury to the sterno-mastoid during parturition, or a false position of the head during gestation. According to Whitman, hematoma of the sterno-mastoid is a frequent cause of congenital torticollis. It has also been attributed to inherited syphilis.

*Acquired* torticollis is a chronic condition and is the variety most frequently found. It is a result of direct nerve irritation which may be: 1st, central; 2nd, along the nerve trunk, and 3rd, due to reflex nerve disturbances from carious teeth, otorrhea, or excessive use of the eye.

The **pathological** changes which occur in the affected muscles are degeneration and shortening, associated with corresponding change in the fascia, ligaments and bones. The muscle most frequently affected is the sterno-mastoid. Next in order are the trapezius, splenius, and scaleni. The posterior neck muscles may be alone involved, when it is called retrocollis. Rarely all the muscles of the neck are in spasm, and very rarely both sterno-mastoid muscles may be involved. In old cases the intervertebral discs are destroyed and osteophytes form, resulting in ankylosis of the spine. Asymmetry of the face and skull, conditions found in congenital torticollis of long standing, has variously been described as due to spasmodic contraction of muscles, to reflex trophic changes, and to interference with the circulation of blood to these parts. Some have considered torticollis in the same category as *tic doloreaux* and others as a reflex neuroses.

**Causes.** D'Arcy Power records fifteen cases of torticollis due to congenital hematoma of the sterno-mastoid, and other observers have recorded one hundred and six cases of congenital hematoma, in twenty-three of which there was developed torticollis. This shows that the deformity does not always follow hematoma of the sterno-mastoid, but it is a frequent sequel. Morse, of Boston, reports a case of rheumatic torticollis associated with erytheema nodosum, and Sinkler reports a case following pneumonia. These cases come under the head of false torticollis.

**Symptoms.** A knowledge of the origin, insertion and innervation of all the muscles of the neck must be had to thoroughly appreciate the position of the head. In spasm of the sterno-mastoid, the head is inclined to

the shoulder of the affected side and the face turned to the opposite side, while the chin is forward and elevated. The trapezius draws the head backward and towards the shoulder, and rotates the head toward the opposite side.

*Pain* is intermittant as a rule and may be absent for weeks or months, but returns with increased severity. It is greater during exercise, and may disappear under absolute rest for a short time. The affected muscles stand out tense, hard and prominent.

**Diagnosis** depends upon a consideration of the following facts:

*First.* The sterno-mastoid is most frequently affected and will be found prominent and the spasm may be tonic or clonic.

*Second.* The chin points from the affected muscle and the head is drawn toward the shoulder.

*Third.* Pain, of an aching or an acute character, appearing intermittently.

*Fourth.* The muscles are not atrophied.

*Fifth.* The asymmetry of the face is found in congenital cases, but it is not present in the spasmodic variety.

*Sixth.* It is most frequent on the right side.

**Differential Diagnosis** must be made from cervical Pott's disease, with which it is most frequently confounded. In the latter condition there will be found a rigidity of the cervical vertebræ, which prevents motion in every direction, while in torticollis motion will be limited in the direction opposite to the muscles in spasm only. Rheumatism of the cervical vertebræ, according to Lanelongue, is liable to be confounded with torticollis, and Lillie has called attention to a rachitic torticollis which is differentiated by the appear-

ance of enlargement of the epiphyses of the long bones.

**Prognosis.** In congenital torticollis cures are made in the early stage. In spasmodic torticollis spontaneous recovery almost never occurs. Under medical, mechanical, or electrical treatment, little can be accomplished. Recent methods of operative procedure has placed this most obstinate deformity within the limits of curable affections.

**Treatment** is subdivided into medical, mechanical and operative. The therapeutic agents may be enumerated as follows: morphine, arsenic, strychnia, bromides, gelsemium and conium. Henrich Weisse, of Vienna, cured one case of spasmodic torticollis by hypodermic injections of two and one-half grains of curara every second day; which may be increased, he says, up to tremulousness. Lazinsky reports one case, and M. S. Ward, of Scranton, another, cured by hypodermic injections of atropia, beginning with 1-200 and increasing up to 1-45 of a grain. Baths, massage and electricity may be used to satisfy the patient of their value and as an introductory to more radical measures.

The *machines* used for the correction and retention of torticollis are numerous and complicated, and are used to force the head back in a normal position, and hold it there with a hope that it will eventually remain so. Reference may be made to the braces of Buckminster Brown, Sayre and Adams, to head bandages and adhesive plasters, as well as to appliances used in recumbency, and to plaster-of-Paris and other forms of collars.

**Operative Treatment.** The only effective means of curing congenital torticollis is by myotomy of the contracted muscles, and in the spasmodic variety, by the latter, or nerve resection.

**Myotomy** is done subcutaneously or by the open method. Subcutaneous section of the sterno-mastoid is best and most safely done from one-half to one inch above the clavicle. First puncture the skin anterior to the muscle with a sharp instrument, and then pass a blunt tenotome under the sternal portion of the muscle and cut outward. Care must be taken not to wound

FIG. 92.

the external jugular vein, which will be found along the external border of the muscle. Before making the section the muscle is placed on the stretch by turning the head about.

The *open method* consists in extending the puncture into an incision backward across the muscle one inch above the clavicle, followed by section of the muscle.

The muscles and fascia should be separated by a blunt instrument, and section made over a grooved director. Little hemorrhage follows, unless the external jugular is cut, in which case it should be tied above and below. The internal jugular has been severed in a number of cases, and the pleural cavity has been entered. After myotomy the head must be held in a super-corrected position. For this purpose one of the various appliances mentioned above may be used. The retaining brace must be worn for months, or at least for some time after repair of the wound has taken place.

Mikulicz, of Breslau, says that extirpation of the sterno-mastoid is the only treatment that is of any use, and he furnishes 17 extirpations, total and partial, and all were cured. Lorenz objects to extirpation, stating that it cannot remedy the spinal curvature, which he considers an important element in severe cases.

**Nerve Section.** More recently the treatment *par excellence* is resection of the spinal accessory nerve. Petit reports 26 cases, 13 cured and 7 much improved. Other papers have been published by Keen, Gould, Gardner and Giles, and Appleyard, and all speak favorably of nerve section, reporting cases to substantiate their position. The resection of the nerve is made either anterior or posterior to the sterno-mastoid muscle. The anterior operation is done as follows: an incision is made from the tip of the mastoid process down along the anterior border of the sterno-mastoid muscle for three inches. The external jugular should be tied and divided if it is found to obstruct the field of operation. The muscle is now dissected out and drawn back, under which will be found the posterior belly of the digastric and the occipital artery, and the

internal jugular vein. The nerve will now be seen to enter the sterno-mastoid one inch below the tip of the mastoid process. It is best to remove at least one-half inch of the nerve. The posterior operation is not quite so difficult, since the nerve is more superficial. Section is made as the nerve gives off branches to the sterno-mastoid and trapezius, half-way down the former muscle. When the posterior muscles of the neck are involved it will be necessary to resect the posterior cervical nerves.

Paralysis of these muscles is of little consequence.

In 1891 Noble Smith said that all methods of treatment for spasmodic torticollis failed, except resection of the spinal accessory nerve, and Richardson and Walton, of Boston, say resection of the nerve affords practically the only rational remedy.

Keen suggests resection of the posterior roots of the three upper cervical nerves, and Powers has repeated the operation with gratifying results. Wm. Gardener Smith thinks it is easy to cut down to, and clearly define the suboccipital triangle, and make section of the first, second and third posterior cervical nerves. The first will be found crossing the triangle, the second outside of the triangle and below the inferior oblique, and the third, one inch lower down the neck than the muscle.

Kocher, in a recent monograph, states that medicines of various kinds, massage, electricity, hydrotherapy, etc., as well as various kinds of apparatus, failed utterly in his cases. This writer thinks that section of all muscles which are found in a state of contraction is a much better operation than resection of the nerves. He explains the beneficial results as being due to a

suggestive action upon the cortical centre and states that as soon as the offending centre in the brain becomes aware that the impulses which it sends out not only do not move the head but meet actually no resistance, it gradually ceases its useless effort, hence the necessity for the division of every affected muscle. He claims as a fact that in a certain time after the myotomy, contractions cease in the proximal (innervated) portion of the severed muscle.

## INFANTILE SPINAL PARALYSIS.

This condition has also been described under the heads of anterior poliomyelitis, teething palsy, etc. It is characterized by a sudden development of paralysis of muscles, or groups of muscles, of one or all extremities, following an acute febrile attack, frequently accompanied by convulsions, and followed by deformity.

The **causes** have been enumerated as exposure to cold and sudden changes of temperature, sitting on the ground or stone steps, exposure to the heat of the sun, falls, etc., but in the majority of cases no cause can be found. Epidemics of anterior poliomyelitis, as reported by Caverly, Cordier, Rissler, and Medin, tend to show that it is an acute infection, due to some variety of bacteria.

Caverly reports an epidemic occurring near Rutland, Vt., in 1894, in which there were 132 cases. Males were more frequently attacked. It was not contagious, as it was rare to have more than one case in a family. Convulsions occurred in 12 cases. Paralysis followed in 119 cases, but in 56 cases they completely recovered. Eight deaths resulted. In the epidemic reported by Cordier, of Lyons, France, there were 13 cases, of which four resulted in death.

The **pathological** changes found are a destructive inflammation of the multipolar cells of the anterior horns of the spinal cord. It may be confined to the cervical or lumbar enlargement, and in cases where the lower extremities alone are paralyzed the lesion is found in

the lumbar enlargement. The muscles involved are always atrophied. The atrophy may be quite extensive, and where an entire extremity is included there will also be found extensive degeneration of every structure including the bone, and measurements will show that the leg is not so long as its healthy fellow.

The disease is divided into **three stages**: *First*, acute or initiatory, during which time the patient suffers with high temperature, possibly convulsions coming on during the night, which last for a day or so; *second*, stage of paralysis, immediately following the acute attack, during which time the paralysis is greatest. There is also some improvement during this stage, and certain muscles may completely recover their power. It extends over a period of from a few days to many months. The *third* stage is known as the stage of retrogression, during which time some of the muscles regain some of their power, and others are found completely paralyzed and remain permanently so. It is during this stage that the deformity begins and without preventive treatment, grows progressively worse. The muscles and the bones become atrophied. This stage includes the rest of the patient's life. The extent of paralysis is not uniform, because it may involve either a portion of a muscle or the muscles of all the extremities and trunk. Usually, single muscles, or groups are paralyzed, as the flexors, extensors, or adductors of an extremity.

**Deformities** which follow infantile spinal paralysis vary from the slightest muscular defect to a condition of complete helplessness, and increase throughout the career of the patient so long as he goes without treatment.

In the upper extremity the atrophy of muscles makes

the arm useless, and the group of muscles unaffected draws the member into a deformity. The shoulder is flat. When the trunk muscles are involved there is lateral curvature, lordosis, and kyphosis.

In the lower extremity the most frequent deformity is some variety of *club-foot*. When the anterior group is paralyzed there is talipes equinus, or if the posterior superficial calf muscles are involved we have calcaneus. If the deep calf muscles are involved we have valgus, or if both calf groups are included there will be calcaneo-valgus. If the peroneal group alone is paralyzed there will be varus, and if this group is included with paralysis of the foot flexors, equino-varus will result. Subluxation of the knee is a common deformity, due to paralysis of the anterior thigh group. This deformity may be associated with any of the foregoing varieties of club-foot. The paralysis may involve any of the groups of hip muscles, resulting in flexion upon the pelvis, adduction, abduction, or rotation. Any of the varieties of dislocation of the hip or other joints may occur.

It must be remembered in considering the anatomical condition of these joints in paralysis that it is not the ligaments which hold the heads of bones together in normal joints, but the muscles which cross over and control the action of the joint. This being the case, when the muscles crossing a joint are paralyzed a dislocation is easily produced by slight traumatism, and may be produced spontaneously.

A **diagnosis** is not usually difficult when deformity exists, but it is not so easy in the first and second stages. Electric reaction of the muscles is always present so long as muscular fibre remain, and is only absent when the normal muscle cells are entirely destroy-

ed. Sensation is not disturbed. The paralyzed extremity is always cold, clammy, peal and lifeless.

A **differential diagnosis** must be made from cerebral palsies, progressive muscular atrophy, diphtheritic paralysis, pseudo-hypertrophic spinal paralysis, and acute myelitis. It may also be confounded with hip-joint disease, lateral curvature or other spinal disease, and rickets.

**Prognosis.** The prognosis is more favorable than in cerebral palsies. It does not tend to shorten life, but the deformities above described will follow, however, if preventive appliances are not constantly worn, in those cases where the tendency to deformity manifests itself. Paralysis does not increase after the acute attack, but instead, in the majority of cases, it improves.

Under proper treatment promises of improvement can be made, if the measures adopted are persistently and patiently carried out for months or possibly years.

**Treatment** may be summarized as follows:

- Preventives of deformity.
  - Medicine.
  - Electricity.
  - Gymnastics.
  - Massage.
  - Braces.
- Correctives.
  - Mechanical. Screw, spring, or other braces.
  - Operative.
    - Brisement force.
    - Tenotomy and tenorrhaphy.
    - Osteotomy.
- Retentives.
  - Temporary.
    - Braces.
    - Plaster-of-Paris.
  - Permanent. Ankylosis secured by operation (arthrodesis), or by injection of caustics.

Medical treatment must be directed to reconstruction of the nervous and general system. Strychnia, iron, and the hypophosphites serve best.

Gymnastics, massage, and manipulations should be constantly practiced, but the first is the principle portion of the treatment. Gymnastics are (1) voluntary and (2) compulsory. By voluntary gymnastics we mean such exercise as the patient freely enters into for pastime, for enjoyment, or because he thinks it will benefit him; and by compulsory exercise, where the surgeon, nurse, or parents enter into exercise with the patient. The former may be secured in playing games, riding the velocipede or bicycle, and compulsory exercise is furnished by force machinery.

Gradual and forcible correction of these deformities is done by machines, and Shaffer and Stillman have given us the best appliance for the knee. To-day, however, tinkering with screw correctives is too slow, and when deformity is found it is corrected if possible at one operation. Operations as above tabulated consist of *brisment force*, with or without tenotomies and osteotomy, which may be from simple subcutaneous section to cuneiform operation. Karewski says two aims are to be sought for: first, to improve the joint without impairment of mobility and, second, to secure ankylosis.

The first is generally the aim in paralysis at the hip where the psoas and iliacus are not paralyzed and demand an artificial opponent.

Immediate correction of a joint in deformity may be done by cutting such contracted tissue as may be found to resist the correction, either subcutaneously or by the open method. Next break up adhesions in the joint and rupture contracted soft parts about the joint. In

the hip the psoas and iliacus will be found shortened, and the joint may be in luxation.

**Arthrodesis,** or the obliteration of a joint to secure fixation, was introduced by Albert. It has been extensively practised by Karewski, Albert, Jones, Vance, and others. It is only to be used when all the muscles of the extremity are paralyzed, and only then when the patient could better use the straight ankylosed joint than a flail joint. Robert Jones has operated on fifteen cases. He advises opening the joint, and with a scalpel or sharp gouge remove the superficial area of cartilage off the whole articulation in the case of the ankle, keeping the joint completely at rest for some weeks subsequently, and for a long time having an apparatus worn which prevents a strain upon the newly made tissue.

The knee may be opened by the Ollier incision, the ankle by a transverse incision and entering the joint external to the flexor tendons, which are held inside. In the elbow, Kocher's incision is best, since it permits a removal of the capsule, which should always be incised.

The author has injected pure carbolic acid into paralytic joints with the object of inducing ankylosis by a simpler method than opening the joint. (Such treatment is now being carried out, but sufficient time has not elapsed to determine its value as a substitute for the open operation in inducing ankylosis in flail joint.)

Summary of *treatment* may be made from the foregoing as follows :

1. If seen early, develop the muscles by gymnastics and electricity, and prevent deformity by braces.

2. If deformity is found, correct it with *brisement force,* tenotomies and osteotomies.

3. When muscular power is completely destroyed,

and an effort to develop it has failed, ankylosis should be induced, either by injection of caustic liquids into the joint to promote adhesions, or by operation.

CASE 26, M. C., aged 17. When two years old he had an attack of anterior poliomyelitis with sudden onset, high fever, convulsions, etc., after which he was completely paralyzed, *i. e.*, paralyzed in both upper and lower extremities. This paralysis was continuous until he was about four years of age, when he began to have some use of his arms and legs. The right arm gained more rapidly than the left, and the left arm more rapidly than the lower extremities. When treatment was begun, 14 years after the onset, he was crawling around on his hunkers, as he had been for all these years, except during the last two or three, when he had been riding a tricycle. As shown in Fig. 93, he had an exaggerated talipes equino-varus of the right foot, which could not be corrected by manipulation, and a subluxation of the left knee at an angle of 45 degrees, and mild equino-varus of the left foot.

Owing to the fact that the deformities had existed for so many years, the bones were held in their abnormal position by dense adhesions. The rule to which prominence has been given by Phelps, viz., cut every tissue that offers resistance, beginning with that which offers greatest resistance, and continue to cut until the foot can be returned to a super-corrected, or at least corrected position, was observed as nearly as possible. Under A. C. E., the tendo Achillis was first tenotomized, the plantar fascia next; and, finally, the deltoid ligament had to be completely severed before the foot could be approximated to the normal. The Thomas wrench, or twister, was used to break up adhesions and rupture the shortened ligaments about the tarsal bones. Great force had to be used with the twister to do this. The tenotomies were of course done subcutaneously. In dividing the deltoid ligament, an artery, possibly a continuation of the posterior tibial, or at least a considerable branch, was cut, but as the cutaneous puncture was about an inch from the point of injury to the artery, pressure soon controlled the hemorrhage. The astragalus, which has been of course dislocated during all these years, could not be reduced, *i. e.*, could not be pushed back between the tibia and os calcis.

FIG. 93. (ILLUSTRATING CASE 26).

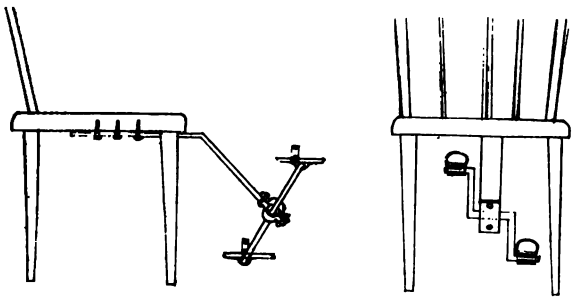


FIG. 94.

EXERCISER FOR LOWER EXTREMITIES ATTACHED TO A CHAIR.

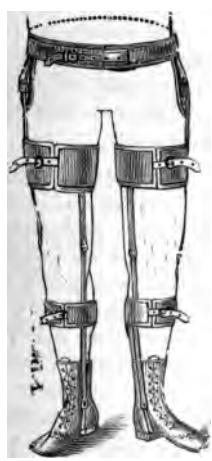


FIG. 95.

BRACES FOR PARALYSIS OF LEGS.

The foot was brought as nearly to a normal position as possible, but was not super-corrected by any means, and was put up in plaster-of-Paris. The skin punctures were dressed with gauze and protective. The plaster-of-Paris dressing was renewed once a week, and the foot held to an extreme point of correction until the plaster was hard. After each adjustment of the plasters the patient suffered great pain in the joint in the region of the astragalus for an hour or so, but he invariably noticed "something slip," and the pain was relieved. As this slipping occurred after every dressing, it was evident that the astragalus was wedging itself back between the tibia and the os calcis, and the forcible correction thus maintained by the plaster caused the soft structures to yield. The success we had in effecting a reduction of the astragalus can be determined by examining the second and third illustrations, Fig. 93.

The subluxation of the left knee-joint required tenotomy of the hamstrings and forcible breaking up of adhesions between the bones and about the joint. It was impossible to completely correct the deformity here as in the case of the foot, *i. e.*, a paralellism could be had between the thigh and leg, but the leg was upon a lower plane than the thigh. This was due to the fact that the head of the tibia did not slip down and forward upon the condyles, and the relationship of these bones was not disturbed. (See page 179).

CASE 27. Clarence G., aged 9. When 11 months old he had fever and severe convulsions. While yet in his mother's arms she noticed that he was completely paralyzed on his left side. He had been able to walk before the attack of anterior poliomyelitis, but it was about one year afterward when he again began to creep, and he did not get upon crutches until three years later, or when about five years old. For the succeeding four years he walked on crutches. (See Fig. 96.) Operation consisted in tenotomies of tensor vaginæ femoris, fascia, etc., to liberate the thigh at the hip joint, and of the hamstrings to correct the subluxation and flexion at the knee. The tenotomies were done subcutaneously. The patient was put up in plaster-of-Paris from the thorax to the heel, and allowed to remain so for about two weeks.

In order to make the plaster dressing lighter and less likely to break over the hip and under the knee, pieces of iron were put in over these joints, as is the practice in the New York Hospital for Ruptured and Crippled.

As a retaining splint, after the first few weeks he wore a Thomas hip brace. It was necessary to use an abduction arm, owing to the great tendency to that deformity. The patient now has entire control of the hip, and is able to walk without crutch or cane.

FIG. 96.—CASE 27.—BEFORE TREATMENT.

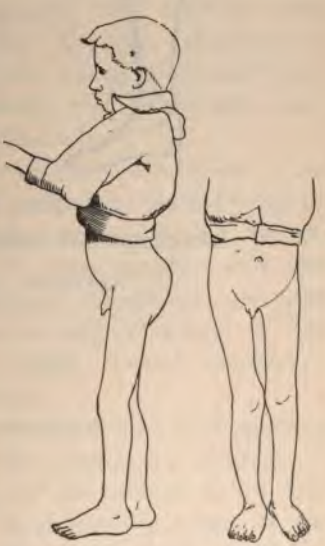


FIG. 97. FIG. 98.
CASE 27.—AFTER TREATMENT.

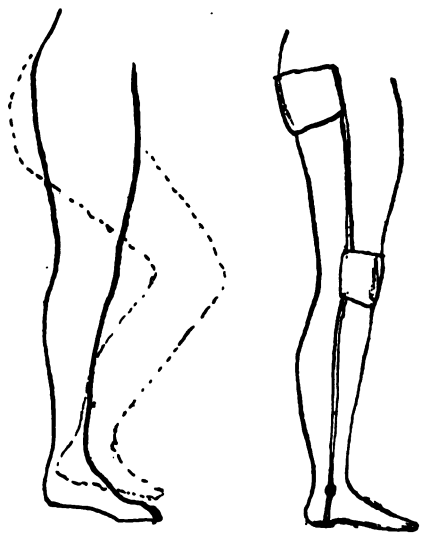


FIG. 99.

BRACE FOR PARALYSIS OF QUADRICEPS EXTENSOR FEMORIS.

## INFANTILE CEREBRAL PALSY.

Infantile cerebral palsy is also known as infantile spastic paralysis. It is characterized by spastic paralysis of muscles and groups of muscles growing progressively worse, with atrophy, is of cerebral origin, and usually associated with some impairment of intellect.

Two varieties are recognized, viz., infantile hemiplegia and spastic paralysis, (Tubby). American authors recognize three varieties, basing the classification upon the symptoms presented, viz., hemiplegia, spastic paralysis and inco-ordination.

The **etiology** as given by Osler and others is: 1. Hemorrhage during convulsions and violent coughing, or injury by forceps or other trauma during delivery, or premature delivery. 2. The eruptive and other fevers, resulting in embolism, encephalitis or microcephalus. 3. Thrombosis of cerebral veins. 4. Consanguineous marriages, fright, mental emotion, or drunkenness during gestation.

The **symptoms of hemiplegia** may be absent until deformity is discovered, the onset being gradual. In some cases the disease may be ushered in by fever, convulsions and coma. In about 50 per cent. of cases there is paralysis of the face, with greater paralysis of the arm and the leg, which continues throughout the course of the deformity. The leg recovers more rapidly than the arm, sensation and electrical reaction remain normal, and the reflexes are exaggerated. Rigid-

ity is more severe during efforts to move the parts, but it disappears during sleep or anesthesia. Aphasia is an early symptom, but disappears as other symptoms improve, although in severe cases it remains as a permanent defect. Backwardness, imbecility or idiocy is found in the majority of cases, although a few cases have no impairment of intellect. Epileptic seizures form a complication in a few cases. The forearm assumes a typical position of flexion, both at the elbow and wrist, and the shoulder is sometimes raised. The thigh is flexed and adducted, the knee is flexed, and

FIG. 100.

FIG. 101.

INFANTILE SPASTIC HEMIPLEGIA (THORNDYKE.)

the foot is in equinus and equino-varus. The entire side is rigid.

**In bilateral spasmodic paralysis** the spastic condition is noticed soon after birth or after an acute sickness. The legs are extended and the thighs are adducted, the legs may be crossed with the feet in equino-varus. The arms are held close to the side, with the hands pronated and in an awkward position. Atrophy may not be marked. There may be choreic spasms of the face and tongue, with strabismus or nystagmus. The gait is awkward. The mental condition is defective and associated with microcephalus. Teeth are defective. Epilepsy is not so common as in hemiplegia. In some cases there is paraplegia. The symptoms are much the same as found in the foregoing varieties. The marked difference is that there is greater deformity of the legs and less impairment of the intellect. In all varieties the gait is peculiar, the head is raised, the toe turns in and drags, and the tread is stiff and jerky, while in infantile spinal paralysis the leg hangs loose, and the gait shows weakness of the affected leg. The pathological changes are those which would result from the causes already enumerated. There may also be cord sclerosis.

A **diagnosis** is not difficult when deformity or contractures exist, but previous to that time it is not easy to differentiate this variety of paralysis from other paralyses.

A **differential diagnosis** must be made from infantile spinal paralysis, cretinism, contractures resulting from nervous injuries, and hip-joint disease. In studying the spastic condition of muscles in this disease it must be remembered that with the rigidity in hip and other

joint disease the joint is stiff, *i. e.*, no motion is permitted in any direction. In the disease under consideration, while the joints are rigid they will yield to pressure and unfold as it were, as a lead pipe is bent, but when pressure is removed the extremity assumes its former position.

**Atrophy** is not so great as in infantile spinal paralysis, and in some cases it is very slight.

**Prognosis** should be guarded. There is generally some improvement, and the disease does not greatly shorten life, unless there are marked cerebral symptoms. A perfect cure can in no case be promised.

The **deformity** can be corrected by operations and mechanical appliances, but there is no certainty that it will not return during the course of a year or so, unless prevented by retaining apparatus, worn constantly.

The **treatment** may first be directed to the pathological changes which produce the deformity, when the case is seen early, as hot baths, cold to the head, purgatives, bromides and chloral.

The *paralysis* demands massage, electricity, and warm clothing; appliances adjusted early to prevent deformity, which consist of braces made to fit the individual case. When deformity is found it is corrected by tenotomy of the contracted tendons, which should be done subcutaneously, and the joint forced into a normal position. Retaining appliances are to be adjusted to suit the case. For immediate retention after operations, plaster-of-Paris must have the preference, and as a permanent support braces are to be devised for every case.

## CHARCOT'S DISEASE.

Charcot's disease is a chronic joint disease due to a lesion of the nervous system and characterized by great destruction and deformity of the joints, associated with tabetic symptoms.

**Etiology.** It is due to a lesion of the posterior columns of the spinal cord. Tumors of the gray matter of the cord, general myelitis, and injuries to the peripheral nerves may also produce it.

**Age.** It is a disease of advanced life.

**Deformity.** While the knee is the joint most frequently involved, it may affect any joint. The shoulder, elbow, ankle, hip and wrist are also seats of the disease. There may be great distension of the joint, due to abnormal accumulation in the cavity and to the displacement of the heads of the bones.

**Pathology.** Every structure in the joint is included in the process of destruction. The epiphysis melts away, or the inside of the head of the tibia and the external condyle are destroyed, allowing the heads of these bones to rest alongside of each other. The tendons, cartilage, etc., are disorganized. Roberts classifies the changes as follows: 1. Chronic asthenic hyperemia of the synovial membrane, a hydroarthrosis. 2. An interstitial atrophy of the epiphyses. 3. Fungous or varifying epiphyseal hypertrophy. 4. The formation of osteophytes and bony stalactites.

**Symptoms.** The onset is rather sudden, and among the first symptoms are the beginning deformity, with-

out pain, absence of patellar reflex, and destruction of the joint. In addition to these may be found the Argyll-Robertson pupil and more or less inability to stand or walk in the dark or with the eyes closed. Patients are able to get about with a cane even when great destruction of the joint with angular deformity exists. As early symptoms there may be weakness

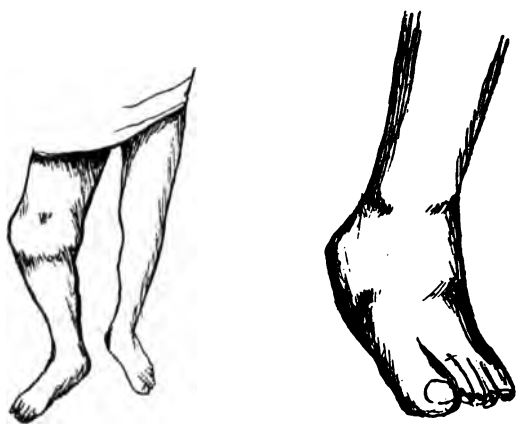


FIG. 102.

CHARCOT'S DISEASE (AFTER YOUNG).

and giddiness with shooting pains through the extremity. The local symptoms of redness and swelling, while not marked, may be found with slight tenderness on pressure during the early stage. There may also be some pain during the early stage. The muscles become rapidly wasted, and electrical reaction is wanting.

**Diagnosis** must depend upon a consideration of the preceding symptoms, which point to the spinal cord disease, with great destruction and free movements of the joint.

**Differential diagnosis** must be made from arthritis deformans, in which there are pain, restriction of motion, the slow onset; from arthropathies in syringomyelia, in which condition the joint involvment is confined to the upper extremities and is characterized by enlargement of the epiphyses; and from arthropathies of acromegaly, in which condition there is present enlargement of the bones and soft parts, especially of the inferior maxillary.

**Prognosis** depends upon the control which may be had of the tabetic condition. If the cord changes can be cut short and improved, the destruction of the joint will stop, although little if any improvement in the joint can be expected.

**Treatment** includes tonics, iodide of potash and strychnia, both of which must be given in large doses. Absolute rest to the joint is necessary. The joint should be supported by splints or plaster-of-Paris, including elastic pressure, as the bandaging of a sponge or cotton about the joint. Massage and electricity must also be used, and S. Weir Mitchell considers the latter of value. When the nervous symptoms have been controlled, excision must be done to give the patient a more useful joint.

## ARTHROPATHIES OF SYRINGOMYELIA.

Deformities of this disease of the spinal cord are confined to enlargements of the upper extremities. People who extensively use the hands and arms are more likely to be affected.

**Pathology.** The central lesion is a dilatation of the central canal of the spinal cord. The usual joint lesion is hypertrophy, although there is atrophy in a few instances. Young says: "The enlargement of the joint is due to vegetary arthropathies characterized by asthenia, hyperemia and interstitial atrophy leading to erosion of the articular surfaces, and fungous epiphyseal hypertrophy." Osteomata of the tendons and muscles are found in this as well as Charcot's disease.

**Symptoms.** 1. The joint lesions show before the sensory disturbance. 2. Development is rapid, with rapid enlargement of the joints. 3. Muscular atrophy. 4. No pain, or fever, or constitutional disturbance. 5. Ligaments softened and relaxed. 6. Lateral movements with crepitation, but without pain. The course is chronic and may continue over a period of from fifteen to twenty years.

**Prognosis** is unfavorable and curative *treatment* is not known.

## ARTHROPATHIES OF ACROMEGALY.

**Acromegaly** is mentioned here since the enlargement of the ends of the long bones which characterizes the trouble is liable to be confounded with Charcot's disease in the lower extremeties and syringomyelia in the upper extremities. It is characterized by an enlargement of the bones and soft parts, especially of the inferior maxillary, which may become enormously enlarged, projecting the lower teeth beyond the upper; the supraorbital ridge, the costal cartilages, sternal ends of the calvicle; later the scapulæ and vertebræ. As later deformities, the hands, feet, and nose may become enormously enlarged.

As a *pathological* lesion, which is no doubt a hint as to the cause, there is found enlargement of the pituitary body and thyroid gland. Sclerosis of the lower cervical sympathetic and hypertrophy of the mucous membrane of the nose are found. As evidence of the central origin of the disease the deformities of the extremities appear bilateral. Headache is a prominent symptom.

**Prognosis** is bad, since no *treatment* is known to cure the disease. The progress is very slow, requiring in some cases many years before a fatal termination.

## PLANTAR NEURALGIA, OR ANTERIOR METATARSALGIA.

**Metatarsalgia** is a painful affection of the foot first described by Thomas G. Morton, of Philadelphia, and frequently known as Morton's disease. It is characterized by pain in the bottom of the foot, generally along the distal end of the metatarsal bone of the fourth toe. It is accompanied in some cases with swelling of the foot and suffering so intense as to make the foot practically useless. Morton first described the condition in 1876, and reported four cases.

T. S. K. Morton has written upon this subject and reported cases. Other articles have been written and cases reported by Meade, Kemper, Goldthwaite, Mason, Grau, Gross, Agnew, Roswell Park, Gibney, Bradford, and Woodruff. The most recent article upon this subject was written by Robert Jones, of Liverpool, who reports seventeen cases. Auguste Paulloson, of Lyons, France, reports one case and calls it "Anterior Metatarsalgia." Whitman, (American Orthopedic Association, 1898). furnishes an exhaustive and masterly resume of the subject.

Morton first thought that the pain was caused by pressure of the head of the fourth metatarsal bone upon the nerve, as it is found immediately underneath it. Goldthwaite, of Boston, says it is due to a breaking down of the anterior transverse arch of the foot.

Robert Jones opposes the views of Dr. Morton, in the following language :

"1. The plantar digital nerves, instead of passing between the heads, lie on the transverse metatarsal ligaments, and when the foot is pressed upon are pushed away from, not between, the bones.

"2. It is not proved that the anatomical position of the heads of the third, fourth, and fifth metatarsals is favorable to a nipping of the nerve on lateral pressure; on the contrary, there would be less escape were the metatarsal heads in absolute line.

"3. In the majority of cases, a painful spot can be found and made intensely sensitive by pinching with the thumb on the dorsal and the forefinger on the plantar surfaces. That such spot is usually quite local, and would not respond to such pressure if, as asserted, the pinched and sensitive nerves were placed between the bones.

"4. In most cases, a broadened foot, due to collapse of the anterior arch, accompanies the affection, rendering the digital nerves less liable to compression. This fact, in conjunction with another, viz., that a broad-soled boot hardly gives any relief in the third degree of plantar neuralgia, is strongly at variance with Morton's theory.

"5. In a large number of cases, grasping of the foot round the metatarsal heads, thus approximating them, relieves the spasm.

"6. Frequent flexion of the toes is an instinctive method of relieving spasm, the flexing of the toes being accompanied by slight approximation of metatarsal heads.

"7. Manipulations of the foot by the surgeon, other than applying direct local pressure, rarely produce the pain.

"I believe that clinical observations accord much better with a theory of treading upon, rather than with that of pinching, a nerve, and am fortified in this opinion by three anatomical facts: (a) The proximity to the painful area of the communicating fourth branch of the superficial division of the external plantar. (b) The collapse of the anterior arch in most of the cases. (c) The bulk of superincumbent body-weight in walking on the toes is borne on the first and fourth joints."

**Treatment.** Treatment of plantar neuralgia must vary with the stage of the affection.

In the first stage they must discontinue such use of the foot that causes pain. Shoes should fit across the instep, have roomy toes, but not too wide, the heel should be built up on the inside so as to slightly invert the foot. The sole should be thick, especially back of the heads of the metatarsal bones. The inside of the sole may be scooped out under the painful point to relieve pressure with profit. Bandages, and adhesive plaster about the instep affords relief and is of curative value. *Operative* measures include resection of the nerve, excision of metatarsal head. Actual cautery to the surface, or a hot needle thrust into the parts have afforded relief, and effected cures. Rarely amputation of the toe may be necessary. Bone operations are seldom necessary since, it is not the bone that is diseased but it is displaced, or is pressing upon other structures, or the arch is broken down and causes discomfort.

CASE 28. M. R., aged about 30, had been suffering with pain in the bottom of the right foot for about two years. All means for the relief of pain, including local treatment, mechanical appliances, and special shoes, had been used, and temporary relief, only, was afforded. A resection of the nerve was suggested and done. Preparation was made to drill the head of

the fourth metatarsal bone, if it appeared at all diseased, and if necessary, excise, but this structure appeared healthy and was left alone. The nerve, however, was larger than normal, and about an inch was resected. The soft structures were freely stretched throughout the region of the operation. The result has been quite gratifying to the patient and satisfactory to the operator.

In making the incision its course should be crescentic, beginning in front of the metatarso-phalangeal joint, extending it around externally to a point immediately under the fourth metatarsal bone. The flap thus made can be dissected from the joint and such operation as necessary performed. The course of the incision throws the line of union between the fourth and fifth metatarsal heads and thus avoids pressure upon the cicatrix such as occurs when the cut is made directly over the head of the bone.

## HYSTERICAL DEFORMITIES.

In addition to the severe varieties of deformities resulting from bone and joint disease already considered, there remains a class of cases more difficult to differentiate, more troublesome to cure and more unsatisfactory generally. They are called functional joint affections, hysterical deformities, and neuromimesis. They may be confounded with real tubercular hip, knee, spinal, and ankle diseases, the paralyses, spastic deformities, lateral curvature, club-foot, etc. To Shaffer is due the credit of making a most exhaustive study of the subject. He enumerates the phenomena presented as "hyperesthesia and subjective pain, rigidity and contractures, spasm and paralysis, malingering and neuro-mimesis, precocity and perversity."

**Frequency**. Brodie says that four-fifths of the joint diseases in the better classes are hysterical and not real. Other observers have found it a frequent joint condition among all classes.

**Causes** which have been named as productive of these apparent joint diseases, are general debility, neurasthenia, errors of refraction in children and young people. Uterine and ovarian disease is frequently an associated condition in girls, or young women, and they result from such influences as produce hysterical manifestations in general. It may be associated with real disease but symptoms are exaggerated. There is no limit to the variety of deformities assumed by hysterical individuals. It must be re-

membered that there is no regularity of the appearance of symptoms. In real disease one symptom follows another in order, and manifestations are based upon anatomy, while in the assumed disease there is no regard for anatomical laws, or uniformity of symptoms. In club-foot cases the foot is usually found in varus. None of the usual symptoms of heat, pain, redness and swelling are present. Atrophy, which is always present in tubercular trouble, is never found in the hysterical cases, except as a result of non use. Varieties of hysterical *club-foot* have been described by Shaffer, Laycock, Shaw, Little, Skey, Mitchel, Sir Charles Bell, Charcot, Adams, and others. Talipes varus seems to be one of the most common forms, if not the most frequent one, in young girls. In extreme cases of this kind the outer margin of the foot alone touches the ground, the sole presenting vertically backward, as in a case described by Little. The anterior and posterior tibial and gastrocnemius muscles may all be tensely contracted. In inversion of the foot in children the probability of the hysterical nature of the affection must always be borne in mind. Such cases are usually unilateral; they are always acquired, often suddenly, and the ordinary indications of disease and disorganization, such as pain, heat and swelling, are absent. Shaffer records four cases. One of these was a precocious and emotional girl of eleven years; another was a boy of ten, who illustrated many phases which hysteria may assume in boys of tender years, paralysis, spinal pain and tenderness, anesthesia, contracture, hyperesthesia, talipes, etc. Among other cases of hysterical contracture which have been recorded in children as well as in adults are those in which the

spasm affected the thumb and masseters. Jacobi has also given a number of interesting illustrations of neuroses of the joints in children from five to twelve years of age. The majority of his cases had been observed about the knee joint, but the ankle and hip joints were by no means free. The internal condyle of the femur, the styloid process of the ulna, and the vertebral column were the favorite places. The same affection, however, had been observed in the sciatic, obturator, crural, peroneal, saphenous, and tibial nerves, in the cervical, lumbar, hypogastric, and sacral plexuses, and in the peripheric nerve branches distributed about the integument, joints, periosteum, and bones.

**Pain.** In all these cases pain is ever present and there is no symptom so unreliable. Pain cannot be measured in a litre, neither can its severity be determined by a mathematical calculation. As a subjective symptom its actual intensity is a relative rather than an absolute quantity. Pain that would require anodynes in one individual is borne by another without even mention of its existance. A tooth-ache in one is almost death, while another may consider it trivial. One individual will go to bed for a week with a boil, and another may have a crop of a dozen and continue at his daily avocation.

The **diagnosis** of hysterical arthritis offers difficulties in three directions: First. It is necessary to exclude a possible arthritis of tubercular, rheumatic or gonorrheal origin. By a careful consideration of the above mentioned symptoms we will be able to overcome the difficulty. Second. The diagnosis becomes more difficult if a hysterical patient should get a real

arthritis. Arthritis presents special traits, and there will be a mixture of real joint affection with nervous contractions, which differ from those of pure hysteria, because they have a real cause. They differ from the contractions of a common arthritis by their excess. Third. It is necessary to be on guard for simulation, as in other hysterical affections, which may present great diagnostical difficulties.

Plicque says "Hysterical coxalgia is *par excellence* a disease with intermissions, remissions and relapses." The slightest trauma is apt to produce relapse. It is, therefore, necessary to protect with great care for a time, the patient against contusions and falls. Pengniez thinks that continued increase of patella reflex indicates that a relapse is probable.

Weak backs and curvature of the spine are frequently hysterical. Such a case has been under observation recently.

CASE 29. Girl aged 25, confined to her bed for one year, and who had for some years previous to that time been walking on crutches and wearing a plaster-of-Paris jacket. During the last year she has worn a jacket, insisting that she could not raise her head, and required support when she took a drink. In this case there was some lateral curvature, which was due to non-use and position in bed, and the jacket was worn as a support to her spine, and not as a correcting appliance. She has had suspension as a remedy. She was practically helpless. With the idea that the condition was greatly imaginary, progressive suggestions were instituted, but the cunning of the patient cut this short and she became offended. She was influenced to go to a faith cure establishment, and the second day she was propped up in bed, the third day sat alone, and the next day she walked across the room, in two weeks walked down street, and shortly thereafter took a street car ride to a distant part of the city. In this case there was evidently no pathological changes in the central nervous system to account for this, other than that in the intellect.

Hip-joint disease is confounded with hysteria. Rickets must be differentiated from hysterical spine even in very young children. Shaffer gives some points on which a diagnosis was made in one of his cases, and they may be quoted here with profit as being applicable to cases of tubercular diseases. They are as follows: "1st, the emotional element in children, easily affected to tears without pain, they seem very conscious of observation and very suspicious of it; 2nd, variable rigidity of muscles; 3rd, flexion of thigh which occurs when the patient sits in a chair, cannot be obtained when the patient is lying down; 4th, patient can put on his own shoes and stockings; 5th, hyperesthetic pain at almost any point of the well leg, or any other part of the body when pinched or touched; 6th, psoas muscles are not involved in the contraction." Shaffer has also called attention to the fact that faradic current produces the usual contraction of muscles in hysterical affections and is diminished in real diseases owing to muscular atrophy.

**Tremulousness** of the extremity is a prominent differential point between false and true joint diseases, as the following case shows:

CASE 30. Miss M., aged 26, had been suffering with pain in her foot for five or six years, had not used it for two years, had had tenotomy of tendo Achillis, and had worn plaster-of-Paris and other splints. The foot was greatly atrophied because the pain was so intense that it had to be bandaged very tightly to a felt splint to relieve it. The constant constriction and the non-use interfered with the nutrition to the part. There was no tumefaction over special bones as would be found in tubercular disease. When the bandage was removed the foot constantly trembled. The joint was not rigid but the motion was limited in all directions. The patient was unable to do anything but sit in a chair with the affected foot on another chair

all day, and had been doing so for years. There was marked spasm of the flexors of the toes and tenotomy of them was done, but no great benefit resulted since the foot remained helpless. After some months of use of appliances, progressive suggestions, etc., without benefit, amputation was advised and done. The wound healed promptly and the patient was wearing an artificial limb in about four months, perfectly recovered. A thorough gross and microscopic examination of the foot failed to show any signs of disease except great degeneration. Observation convinces me that this was a case of hysteria instead of actual disease of the foot. It must be recalled that the patient at no time had temperature, either local or general, swelling or tenderness, as would be present in tubercular or other bone or synovial disease. The symptoms, tendon contraction and distortion, were those which were under the control of the will. The tremulousness especially marked in this case is a most valuable diagnostic sign.

CASE 31. Equally as marked a contrast may be presented in the report of a young girl aged 14, who had had pain in her left humerus for some months. The patient said it was very severe, in fact so severe that she must have morphine or something must be done to relieve her. There was no local or constitutional evidence of disease, except she had a slight temperature occasionally, but this was not regular. Pain, pain, she would say. After the usual remedies, internal and external, for real and apparent diseases, including placebos, hypnotism, etc., I suggested a drilling of the humerus. This was accepted and the operation was performed. A probe was passed through the drill hole, up and down the central canal of the humerus, but nothing but healthy structure was found. The wound was closed and it healed by primary union, and without a complication. Later reports show that the pain disappeared without further treatment.

**Treatment.** Moral treatment is of the greatest importance in hysterical joint diseases. The prospect of recovery depends largely on the confidence the physician is able to inspire in the patient, and upon the surroundings. The methods of local treatment have been

numerous. Electricity, magnetism, metallo-therapy, inunctions with belladonna ointment or subcutaneous injections of atropia, with massage, have been used. If the diagnosis is sure, Brodie, and many others with him, advises against immobilization and rest in bed, and to try to make the patient walk a little every day. If she refuses, electricity, massage and passive motion may be tried. If there is the slightest suspicion that a real arthritis is the cause of the complaint, complete rest becomes absolutely necessary. We possess in the permanent extension by a weight a method of great benefit in both diseases, and it ought, therefore, to be our choice in hysterical coxalgia. It is most beneficial to commence with a smaller weight, and not increase beyond five or six pounds. The pain disappears first, the abnormal positions straighten out little by little, and the patient will gradually be able to sit up and walk around a little during the day; even then it is advisable to continue the extension during the night. Plicque warns against the use of narcotics, even if the pains are said to be severe. The treatment of an organic trouble causing the disease has in many cases cured the condition.

CASE 32. An interesting case has been under my care. Girl aged 20, had been confined to bed, in hospital and at home, for almost 2 years. She had worn a Buck extension for hip disease in a hospital for months. When the case was seen the leg was helpless but there was no rigidity of the joint. Pain as represented by patient was severe. A long Sayre brace was applied with the idea of getting the patient out of bed, and in about six weeks she had her clothing on, and in two months she was put out of doors on crutches. This was followed by trips about town and to the country. Unfortunately she discovered a tumor of the abdominal cavity which caused her to vomit most profusely; she was unable to eat anything. The

vomit was said to contain blood but the writer was unable to see the blood. An abdominal surgeon decided that there was no tumor. The hip brace had been removed and the hip was well, but she remained in a stupor for more than a week, and emaciation was great. The writer decided to use progressive suggestions, and medicine was ordered with the statement that it would digest anything but that she must begin to eat gradually. A local application was prepared to remove any abnormal tumor. In one week the patient was up, and she was ordered to meet me at the door and let me in, in two weeks, which she did. She visited the writer's office in three weeks, and in four weeks went to the country.

# DEFORMITIES AND DISEASES OF BONES AND JOINTS DUE TO BLOOD CHANGES.

## THE CAUSE OF DEFORMITY.

Introductory to the chapters on rachitic and other deformities of long bones, it will be of interest to briefly consider the recent theories as to the cause of these distortions.

The Volkmann-Heuter pressure theory has been the only explanation of the cause of bone deformities. This theory is that pressure of muscles, etc., upon the surface of long bones causes atrophy, and that the bone increases in size on that side where no pressure is made. To illustrate: in case of bow-leg the pressure on the inside, or concave side of the tibia would cause atrophy, or diminution in the tissue, resulting in an increase in the curvature, and the increased pressure upon the convex side increases cell proliferation and consequent thickening of the parts, which with the diminished pressure upon the concave side would increase the curve of the bone.

Julius Wolf now argues that the "pressure theory" is incorrect and that just the reverse is the proper explanation of these deformities. In his work entitled "Functional Pathogenesis of Deformities," the Cullman discovery, viz., that the course of the trabeculæ in bone spongiosa depends upon the pressure and tension made upon the exterior of the bone, is taken as a basis. He states that "abnormal increase of tension and pres-

sure instead of producing atrophy, as the pressure theory would have it, does just the opposite, resulting in accretions of bony material. The amount of bone thus added is proportional to the increase of burden at every point in the bone; therefore, the greater the pressure at any one place the greater is the amount of bone which must be here laid down to resist it." By means of many bone specimens of angular deformity, curvatures and deformities in the narrow sense, he has shown presence of thickening of the corticalis and condensation in the spongiosa on the concave side, *i. e.*, on the side of increased pressure, and just the reverse on the side of diminished pressure, or convex side.

Wolff's second proposition is that the normal shape of bone, as well as that occurring under pathological conditions, is always a matter secondary to the function of the bone, which function is the primary and determining agent to be sought for. It is shown that the external contour of the bone and its internal architecture, correspond exactly; the external contour represents mathematically simply the last curve uniting the ends of the various curves which make up the internal architecture.

Whitman in his article "The Etiology of Deformities," concludes as follows: "If it be true that the upright posture is an evidence of the higher position of man in the scale of evolution, and if it be true that this higher position is due solely to the more advanced condition of the brain, which controls the reflexes and forces the members to perform the more difficult task which the upright posture entails, is it not reasonable to infer that when the controlling force is impaired or removed, the member now influenced or controlled by

a lower center will tend to fall backward toward a lower and less definite attitude? If, however, the balance of nervous energy is retained the structures of the body, either in bone or muscles or other constituents, is incompetent for the strain of an attitude which the stimulation of the higher center forces upon it, then the resulting deformity, whether general or local, will be properly called postural because it is due to the force of gravity."

## RICKETS.

**General Consideration.** Rickets is a constitutional disease, generally of children, characterized by disorders of the digestive system and manifesting itself in alterations in the shape and form of the bones.

**Etiology.** Mal nutrition must be considered the principal factor in its production. Various theories have been advocated as causes, as the acid, mineral, vaso-nervous and inflammatory; and until recently the idea that an excess of lactic acid generated in the intestines by excessive fermentation acted as a solvent of the calcium salts from the bone, was generally accepted, but this has been disproven. Anatomical studies have demonstrated the fact that the blood vessels are always larger in rickets, which results in congestion of the bone. The dilatation of the blood vessels is no doubt due to the general constitutional weakness. Garrod and Fletcher enumerate the causes of rickets as (1) ill health of the mother during pregnancy, (2) want of fresh air and exercise during pregnancy, (3) numerous and rapid pregnancies, (4) multiple pregnancies, (5) age of mother at time of birth, (6) lactation during pregnancy, (7) heredity, and (8) syphilis. Tilbury Fox says that children of mothers who menstruate during pregnancy are more likely to have rickets. Joukwoski says that more than half the children of St. Petersburg die before the age of ten years, and 60 per cent. of all children under five years of age are rachitic. Gee found that 30 per cent. of all sick children under

the age of two years were rickety. Ritter, of Prague, found 31 per cent., and Parry, of Philadelphia, 28 per cent. of children under five years old rickety. The observation has been made by Snow, of Buffalo, that the reason Italian and negro children are so frequently affected is that there is a deterioration of a southern race in a northern climate, and his observation is not without basis.

**Varieties.** As per the classification of the majority of authorities, four varieties are recognized, viz.: 1st, congenital; 2nd, infantile; 3rd, adolescent, and 4th, senile.

**Congenital** rickets is quite common in some of the charity lying-in-hospitals in densely populated European cities, notably Vienna, where 80 per cent. of all born are richitic, but in this country it is not so frequently found. *Infantile* rickets is the variety which comes under our consideration and which concerns us most. It usually develops after the sixth month, and most frequently before the second year. It manifests itself in curvatures of the long bones, enlarged head, and tardy closure of the fontanelles. Adolescent rickets is characterized by curvatures of the long bones and of the neck of the femur. It developes about puberty. It will receive special consideration under the head of "Coxa Vera." *Senile* rickets is found most frequently in Germany, and is a continuation of the early deformity throughout advanced life. Tubby mentions *scurvy* rickets as another variety, but at present this condition is described as "infantile scorbutus" and will be considered separately.

**Pathology.** The bones during the course of the disease pass through three stages, viz.: 1st, congestion;

2nd, softening; 3rd, sclerosis. The dilated condition of the blood vessles formerly referred to, results in hyperemia and this interferes with the nutrition of the bone. The periosteum thickens and is red, beneath which the bone is spongy and arranged in layers, and the normal compact bone is displaced. The diaphyso-epiphyseal cartilage is now congested, or it may be transparent and enlarged, and this congestion afterwards extends to a uniform tumefaction of the epiphysis. Many joints may become involved at the same time, notably the ankles and wrists.

**Deformities.** Almost any bone in the skeleton may be deformed, but distortion most frequently occurs in the lower extremities in the form of bowleg or knock-knee. The forearm, clavicle, humerus, skull, and thorax are all frequently misshapen. The spine is frequently distorted, and this must be differentiated from lateral curvature and Pott's disease. The curve in rickets is usually antero-posterior, describing a gradual circle and disappearing when the child is confined to bed for a day or so Rachitic torticollis, or a distortion of the cervical region, has been described by Phocas. In the chest the most characteristic deformity is the beading at the costal ends of the ribs, and curvature of the clavicle which may be associated with dislocation at the sternal end. The skull is enlarged and box shaped (caput quadratum), the fontanelles are tardy in closing, even to the sixth year, and the sutures may be defined long after birth. Cranio-tabes, or crackling elicited by pressure, is characteristic of rickets, but may also be found in hereditary syphilis. The forehead is high and prominent. The intellect is somewhat impaired. The *pelvis* may be deformed and re-

main so throughout life. Women with this deformity get married but normal birth cannot take place. Deformity occurs during the first and second stages, and restitution also takes place, if at all, at this time. When it does not occur before the third stage, or that of sclerosis, operative interference is necessary.

**Symptoms.** The abdominal viscera are somewhat enlarged, and intestinal irritation is usually found, made manifest by constipation or diarrhea, usually with flatulence and occasional vomiting. The abdomen is distended. The skin is pale and ashy, and becomes hot and dry during the later stages, especially of the extremities, while the head, at the same time, is in perspiration. Sweating of the head and back and fever at nights are almost always found. Dentition is delayed; the teeth erupt out of order, are irregular, deficient in enamel, and soon decay. Bronchitis is a frequent symptom not infrequently associated with pneumonia with a fatal termination.

**Diagnosis.** To summarize the foregoing, we find as marked and the most frequent conditions the following; fretfulness, intestinal irritation, diarrhea or constipation, distended abdomen, sweating of the head, neck and abdomen, with dry and hot extremities, especially the feet, delayed dentition, box head, open fontanelles, enlargement of the epiphyses, beading of the ribs, and curvatures of the long bones.

The **deformity** of rickets must be differentiated from scoliosis and hip disease. Levrot saw five cases which had been taken to him for hip disease, and ten cases of lateral curvature which had enlarged wrists and other evidences of rickets.

**General treatment** may be given as follows: Fresh air,

and generous diet, including rich milk, meat juice and fruit juice. In constipation, inunctions of castor oil over the abdomen. Under the above regimen, medicines are hardly necessary, except it be some variety of tonic, as syrup-of-hypophosphites.

Craniotomy, Caesarean section, osteotomy of the pubis, and more recently symphysiotomy, are operations devised to promote delivery in *rachitic mothers*. Macewen says osteotomy of the pubis is perfectly justifiable when delivery cannot be affected in any other way. Symphysiotomy is much more easily performed, less hazardous and in every way to be preferred.

The forearms in severe cases are curved as are also the tibia and fibula. The radius is enlarged at the wrist and at the elbow. Osteotomy may be done if the bones are not straightened by other means before the age of four years.

Of the deformities of the lower extremities, *genu varum* (bow-leg) and *genu valgum* (knock-knee) are most frequent and require special consideration.

The writer saw one case, in the clinic of M. J. Roberts, with anterior curvatures of both tibiæ and fibulae and both radii and ulnae upon whom eight osteotomies were made at one operation, the patient recovering without an unfavorable symptom.

**Genu Varum,** or bow-leg, is the most common variety of deformity. It is almost invariably a giving way of the supporting power of the tibia immediately below the head of this bone.

A second curve of the tibia is found above the malleoli in very aggravated cases. Less frequently the primary or greater curvature is found above the con-

dyles or in the lower fourth of the femur.

**Genu Valgum,** or knock-knee, is due to curvature in the tibia and femur or elongation of the internal condyles, possibly most frequently the latter.

**Treatment** may be subdivided as follows: dietetic, medical, manual, mechanical, operative.

The rule that operative interference should not be resorted to under *four* years of age is a good guide. The reason given is that the bones are quite soft and will yield to manipulations and mechanical pressure before that age.

In case the deformity is marked, at or after this age, mechanical treatment will do little good and surgical interference is demanded.

Children rarely show rachitic tendencies when nourished at the mother's breast. When they are deprived of this form of nourishment cow's milk should be used in preference to artificial food. Fruit juice, and beef juice, soup or gravy, are essentials in the feeding of rachitic, or scorbutic children.

**Medicines** should be administered sparingly, preparations of iron, phosphorus and lime being preferable.

Manipulations of the extremities daily, or two or three times per week, is of great benefit. In case of bow-leg, with the primary curve below the knee, this is carried out by grasping the head of the right tibia with the left hand and the malleoli with the right hand and gradually but forcibly bending the ankle outward, repeating this a number of times. It will be found that the bones are quite yielding. For the left leg the reverse is carried out.

**Mechanical treatment** for bow-leg. Of the innumerable braces invented, nothing seems to stand the

test of time and do the work so well as the Knight for curvatures of the tibia, but it is of no value when the curvature is in the femur. The brace has two pressure points upon the inside of the leg, viz., the internal malleolus below and the head of the tibia with the internal condyle above. The counter-pressure is made upon the convexity of the curve at the greatest prominence, by the use of straps and buckles. The Knight brace has an extra bar back of the leg, which prevents it from becoming twisted around. If the curvature is in the femur a higher pressure point must de selected along the femur and a joint made in the brace opposite the knee.

In **knock-knee** mechanical treatment is not so effective as in bow-leg at the same age. Here there are but two points, viz., external malleolus below and the femur below the trochanter above, counter-pressure being made upon the internal condyle of the femur by the knee-pad. In this brace a joint is made opposite the knee.

**Operative treatment** may be sub-divided as follows: osteocampsis, osteoclasis, osteotomoclasis, (Hopkins) subcutaneous osteotomy, cuneiform, or multiple osteotomy.

**Osteocampsis** is a bending of the bone, and may be considered an exaggerated manipulation. This may be done by the use of the hands or by an osteoclast.

The author desires to emphasize the importance of bending the bones with the hands under an anesthetic, as a means of correcting rachitic curves. The bones are generally soft, and readily yield to slight force, but if fracture should occur, it is not objectionable since union will occur long ere the plaster-of-Paris dressings should

be removed. The immediate correction under an anesthetic as suggested, greatly shortens the course of treatment and is to be preferred to the simple use of braces even in children under four years of age, and

FIG. 103.
BOW-LEG BRACE.

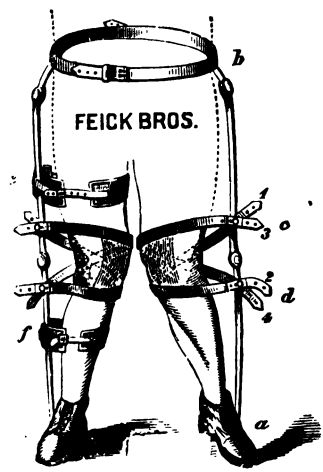



FIG. 104.
KNOCK-KNEE BRACE.

during the time when the bones are very soft.

**Osteoclasis** is the proceedure carried to a green stick fracture, or beyond this sufficiently to correct the deformity, by the use of some mechanical appliance. In the operation damage is done to the soft structures at the joints where the pressure is applied by the pads of the osteoclast.

The Lorenz osteoclast is probably the best machine now in use.

Dr. W. Barton Hopkins has coined the term osteoto-

moclasis, and describes a procedure for correcting deformities of bones associated with rickets or for deformities following fractures in the following language:

"Briefly stated, two operations are done, incomplete osteotomy and osteoclasis. At the first operation the bone is divided with a chisel not completely, but through more than one-half of its thickness at its inner curve. After the skin wound has healed, but before repair of the bone has sufficiently advanced to restore the original strength at the weakened point, a period easily included between one and three weeks, the osteoclast is applied, and the deformity corrected by a fracture in the bone at its weak point."

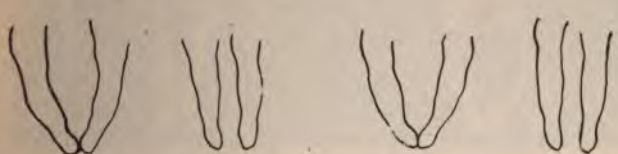


FIG. 105. FIG. 106.

BEFORE AND AFTER BRACE TREATMENT.

**Osteotomy,** done subcutaneously and under antiseptic precautions, it is to my notion the method to be preferred, as the means of operative procedure, after manipulations and mechanical treatment have failed. It leaves nothing but a simple fracture to treat, and is well in thirty days, with but two dressings. In bow-leg one simple subcutaneous osteotomy is generally sufficient. In knock-knee, however, a second or double operation is often demanded, and it is frequently necessary to remove a wedge-shaped piece from the curved surface before correction can be made. It is important

to see that the toes sustain a proper relationship with the patella, etc. It is necessary in some cases after the bone is fractured to evert the foot in bow-leg, and invert it in knock-knee.

FIG. 107. FIG. 108.

CASE 34.—BEFORE AND AFTER OSTEOTOMY.

Attention is called to the tracings in two cases shown in Figs. 105 and Fig. 106, the left in each representing the deformity when treatment was begun, and the other shows the improvement attained with braces.

Case 33, Fig. 107, aged five years, with double bow-leg, the primary curvature was immediately below the head of the tibia. The latter might be disputed by one who does not thoroughly appreciate the fact that the space between the internal tibia line and skin line is filled up by soft structures, and what appears to be the greatest curve below is much less than the upper curve.

Fig. 109.

Fig. 110.

Case 33.—BEFORE AND AFTER OSTEOTOMY.

Fig. 111.

Fig. 112.

GENU VALGUM.

Operation was a subcutaneous osteotomy with a Vance chisel. The cut was made upon the antero-internal aspect of the tibia, an inch or so below the diaphyso-epiphyseal line. The bone is not cut entirely through with the chisel, but only far enough to admit of a fracture. The wound thus made is little more than a needle puncture and is less dangerous. The wounds were dressed with iodoform gauze and rubber tissue protective, and the legs put up in plaster-of-Paris and allowed to remain until the fifteenth day, when the first dressing was made. The second dressing was made on the thirtieth day, at which time the patient could stand. Plaster dressing was continued for about fifty days. There was no pus and no elevation of temperature. Result in Fig. 108.

Case 34, Fig. 109, required very much the same operation, and the after treatment was the same except the plaster-of-Paris dressings had to be removed more frequently because the patient had enuresis and they were constantly soiled. The result is shown in Fig, 110, the knee being tilted slightly forward. In this case we had no pus and no temperature.

Case 35, Fig. 111 shows one of the most aggravated forms of knock-knee and anterior curvature of the tibia corrected mechanically.

Case 36, Fig. 112 shows a marked deformity corrected by osteotomy. The patient was six years old and the bones were very hard. One operation was done on the tibiae near the knees.

## COXA VERA.

**Coxa Vera**, a bending of the neck of the femur, is a disease of youth occurring in tall slender individuals, generally boys or young men, with poorly developed muscular systems, who are required to do work which puts the hip joint to extraordinary efforts. As it is considered a variety of rickets, causes which produce this condition enter as etiological factors. It may be found in children, but mostly occurs in boys of from 14 to 22 years.

Whitman considers it a result of carrying heavy loads, especially at puberty.

Tubby enumerates the usual symptoms as follows:

"1. *Age;* generally adolescence, less after childhood.

2. Class of patient; those who carry weights or do much walking and are subjected to prolonged fatigue.

3. Onset; peculiar stiffness of the hip referred to growing pains; the stiffness is worse on rising after sitting for a time, but is relieved by complete rest.

4. Limping, if one side is affected; waddling if both sides are affected.

5. Shortening amounts to as much as 1½ inch.

6. Prominence of the trochanter, especially on flexing the thigh.

7. Displacement of the trochanter above Nelaton's line and backward as well.

8. Rotation outward of the limb and eversion of the foot.

9. Limitation of inversion and final loss of abduc-

tion, with, in extreme cases, scissors legged progression and inability to walk without crutches.

10. Tilting of the pelvis and consecutive scoliosis.

11. Rachitis in some cases as occurs in children.

Negatively :

1. No local swelling (except that presented by displaced trochanter), or tenderness on pressure.

2. Absence of up and down movement on traction characteristic of congenital displacement.

3. Suppuration never occurs, or thickening of the trochanter." Whitman found flatness of the feet.

Fralier makes an extensive study of the subject of coxa-vera. He reports 41 cases, as appended to the report of Hofmeister's article. He bases a diagnosis upon the following points :

"1, Atrophy; 2, the position of the trochanter in relation to Nelaton's line; 3, the relative length of extremity, measured from anterior superior spine to internal or external malleolus; 4, actual length of extremity, measured from the tip of trochanter to external or internal malleolus; 5, extent of outward rotation; 6, limitation of inward rotation; 7, restriction of abduction or adduction; 8, disturbances of flexation or extension."

**Pathology.** The change in the normal angle of the neck of the femur, of 28° to 66° according to Tubby, is due to a softening of the bone as occurs in bow-leg and knock-knee.

Whitman says there is also an outward rotation of the entire thigh, due to a change in the lateral angle of the neck of the femur.

Flexion and extension are not limited in range of motion, while adduction is limited to about one-third

of the normal range, and inward rotation is also limited when the feet are in a perpendicular line. The scissors position of the legs is permitted on account of this bending.

A number of Europeans have reported cases of this deformity, and Schede says he has seen it in rickety children who had never walked, suggesting as a cause the contraction of the trochanteric muscles. Pain is an early symptom but it disappears as the deformity becomes fixed.

Two classes of cases are recognized : 1st, those occurring in children associated with other signs of rickets, and, 2nd, those developing in adolescence, without other lesions as a rule.

**Treatment** as given by Whitman is, 1st, to remove the exciting cause, that of overwork. In some cases simple cessation from work will suffice. 2nd, local massage, exercise, and manipulations, and passive motion in the direction of the restricted motive, on the principle of manipulation in the treatment of simple deformities of the knee and foot. 3rd, in advanced cases, osteotomy below the trochanter, on the principle followed in deformities of the knee, because the disability is caused by adduction of the legs more than by actual shortening. By osteotomy with consolidation, and the legs widely separated, one may, to a certain extent, replace the head of the bone in a relatively proper position and relieve the extreme outward rotation.

From a summary of cases thus far reported, with the histories given, we must conclude that it is an acute disease due to malnutrition, the external evidences of which are found in fretfulness, fever, emaciation, bone lesions, etc. That the general profession does not understand this condition is quite evident from the fact that attention has been but recently called to it. Many who have read these reports insist that it is nothing more than early rachitic manifestations. In Germany the disease has been known for some years as acute rickets, and similar reference has been made to it in England previous to the Barlow lectures.

**Causes.** Malnutrition is the cause *per se*. The demands made by the system appeal to the intellect of adults and children, but infants are compelled to live on what it pleases the parents and nurses to order for them. When the system is praying for albuminoids and fruit juices, milk (generally impure), crackers and potatoes are given. Flint has said, and wisely too, that to diet a healthy stomach is to create a dyspeptic. An extensive and general menu cannot well be written for patients, because food that agrees with one may disagree with another.

The sea biscuit scurvy of sailors, the hard tack and rusty bacon scurvy of soldiers, are only manifestations of an unsystematic supply of food. It is rare to see cases of scurvy in infants nourished at their mother's breast. Artificially fed infants

are never perfectly nourished. It is difficult to select for an infant deprived of its mother's milk the artificial food which will agree with it. In fact, it is not unusual to try many kinds before one is found acceptable to the patient, and a food upon which an infant appears to thrive in the beginning may be found to disagree after continuous use. Experience has further demonstrated the fact that sterilized milk, or Pasteurized milk, does not always agree with artificially fed infants. Rickets is most frequently found among the poorer classes and in the country especially among the negroes and the poor foreign element. The reverse is almost always true with scurvy in infants. While we see rickets in hovels and alleys, scurvy is most frequently found among the children of prosperous people.

**Symptoms.** In the more advanced cases we have pain, edema and paralysis of the lower extremities, often constipation, occasionally diarrhea due to intestinal irritation, anxious expression, wrinkling of the transverse rugae of the forehead, dilatation of the superficial veins is generally present, especially over the abdomen, even to a marked *caput medusæ*. Bleeding gums are not found as a rule before dentition, and it is only after teething is well advanced that this symptom is to be found. Dentition is always tardy. The most striking and constant pathological finding is a sub-periosteal hemorrhage that may effect any or all of the bones of body. Osteoporosis, fractures in the neighborhood of the epiphyses, deformities due to these changes, and to the development about the upraised periosteum of a bone-like material, are common occurrences. A hemorrhage beneath the periosteum of the lower orbital wall produces in some instances a protrusion of the

eyeball downward and outward. Hemorrhages into the muscles and into the bone marrow are met with.

Clinically, scurvy is met with in artificially fed children particularly the rachitic, usually before the age of two years. The subperiosteal hemorrhages produce swellings of the diaphyses of the long bones beginning in the lower extremities; intra-muscular hemorrhages can often be made out, occasionally there is hematuria, or subcutaneous extravasation; there is rarely any redness of the skin, which, though tightly stretched, fails to show local edema. A paretic or pseudo-paralytic condition of the limbs develops. Anemia seems to be proportionate to the number of bones affected and the extent of the hemorrhage; the gums in children with teeth may be affected. Barlow denies any connection of this peculiar disease with rheumatism, syphilis, hemophilia, or purpura hemorrhagica. He admits that most children thus affected are also rachitic. He believes the disease is a form of scurvy because:

1. It occurs in poorly and artificially fed children.

2. Proper diet and anti-scorbutic treatment result in rapid improvement.

3. Hemorrhages into muscles and beneath the periosteum are common in scurvy in adults.

4. In the cases where scurvy has been excluded because of the non-involvement of the gums, the gums have generally been toothless. Where teeth have been present the scorbutic changes in the gums have been found. Even in the toothless aged, well marked scurvy without gum involvement is met with. Barlow concludes that the affection is not, as the Germans have contended, an acute rachitis. Treatment is followed by brilliant results. The giving of milk, beef-tea,

fruit juices, etc., usually results in a rapid cure.

**Differential Diagnosis.** Scurvy may be taken for Pott's disease, rheumatism, rickets, sarcoma, osteitis of the extremities, infantile spinal paralysis, etc.

In scurvy restlessness is very prominent, while in rickets it is seldom present.

**Deformities.** The most frequent deformity is antero-posterior curvature of the spine, which is not infrequently mistaken for Pott's disease. In occasional cases the curve may be lateral. The rigidity found in true Pott's disease is not present in scurvy. After a few days recumbency the curvature disappears. Enlargement of the sternal end of the clavicle, ends of the long bones, especially of the malleoli and lower end of the radius and ulna, is generally present. Enlargement of the costal ends of the ribs, or "beading," is usual. Bulging of the forehead and an abnormally large head, is not infrequent. (Shown in case 39. See tracings. Fig. 114)

**Treatment** can best be presented in a report of cases which are appended.

Case 37, B., aged 8 months. had been suffering for about three months with high fever, emaciation, fretfulness, edema and paralysis of the lower extremities. The case was presented for examination for curvature of the spine with a view to the adjustment of a brace. The condition of the spine can be seen in Fig. 113; as well as the beading of the ribs, box head and "pot belly." The enlargement of the sternal end of the clavicle, both ends of the fibulae and the lower end of each radius was well marked. The fever ranged from 100 to 102 degrees. Marked constipation, with clay scybalae. *Caput medusæ* encircling the umbilicus and covering a greater portion of the abdomen was a marked condition. The mother or nurse was up twenty or twenty-five times every night, and constant attention was demanded by the child. The patient had been taking pasteurized milk, condensed milk of various brands, and

FIG. 113.

SPINAL CURVATURE OF SCORBUTUS, RESEMBLING POTT'S DISEASE.

milk powders. In this case it was not so much the fault of the milk as it was the lack of certain elements which made it fall so far short of being a perfect food.

**Treatment.** Orange juice, Pasteurized milk, castor oil inunctions over abdomen for constipation, and plenty of cold water to drink. To briefly summarize the treatment in this case, every variety of artificial food has been used, and orange and meat juices in varying quantities were prescribed. The patient would improve and then retrograde, but on the whole made a gradual improvement. In a month the patient was markedly better and in three months was practically well. Pasteurized milk and malted milk with meat and orange juice were the principal articles of diet.

Case 38, Esther F., aged five months, gave a negative family history. Mother died shortly after the birth of the patient. Five different brands of artificial food had been tried and retried, but the patient did not thrive. She lived in one of the most healthy of our suburban towns. On August 15th, 1895, the case was first seen. She was emaciated, crying with a sickly whine, her scalp was covered with small boils, the fontanelles open, the feet swollen, and she had a paralysis of both legs. She was constipated, with clay stools; fever was present almost constantly, occasionally to 102 degrees and she was restless during the night. The deformities present were curvature of the spine, beading of the ribs, enlargement of the external ends of the clavicles and distal ends of the radius, ulna, tibia, and fibula, and the head was of the characteristic box type. The "pot belly" was quite marked.

The following treatment was ordered at once: Malted milk, expressed juice from one pound of meat, and juice of one orange, daily, plenty of cold water, alcohol sponge bath twice daily when patient has fever, castor oil inunctions over bowels for constipation, and constant recumbency in bed.

There was no improvement until August 19th, when she was sleeping better, the bowels were in better condition, and the patient was able to smile. On September 2nd, she had gained one pound in weight; the cheeks were plump, and there had been no fever for about one week. She had been unable to move her legs from June 30th to August 23rd. On the night of the 23rd she had a very bad night, the first for some time,

evidently suffering with great pain in the legs. On the morning of the 24th she was able to move the legs, and the improvement was gradual but continuous. On October 21st she was practically well. No drugs had been prescribed during the treatment.

*Remarks.* The treatment as above given was changed occasionally as the case appeared to demand it. When she did badly for a day it was evident that the food was not given in proper proportions. The restlessness and fever disappeared as soon as this error was corrected. There was no bleeding of gums, but teething did not begin until she was one year old.

CASE 39. W. D., aged 14 months, lived in one of the most picturesque points in Pittsburg. The family history was negative. She was artificially fed from birth. She had measles in February, 1896, and had never properly recovered from this attack. Various brands of condensed milk and artificial foods had been used, but it became necessary to discontinue all of them. On August 20th, 1895, her temperature was 102° F., and for some months she had an evening temperature, and was constipated. *Deformities.*—The head was very large with a bulging forehead, as shown in the tracing, the fontanelles were open and both external malleoli, the lower end of the radii, and the external epicondyles were enlarged. Beading of the ribs and spinal curvature were also present. There was loss of motion, and edema of the lower extremities existed to a marked degree. *Treatment*—Orange juice, beef juice, cold water, malted milk, and castor oil inunctions over the bowels were ordered. She did not improve, and various changes were made in the food, until it was found that sterilized milk agreed with her. Recumbency in bed was ordered. Her improvement may be studied from the tracings of the skull and the spine. The skull actually changed in form so rapidly as to be noticeable to the mother and nurse. See Fig. 114.

In the report of the committee appointed by the American Pediatric Society to make a collective investi-

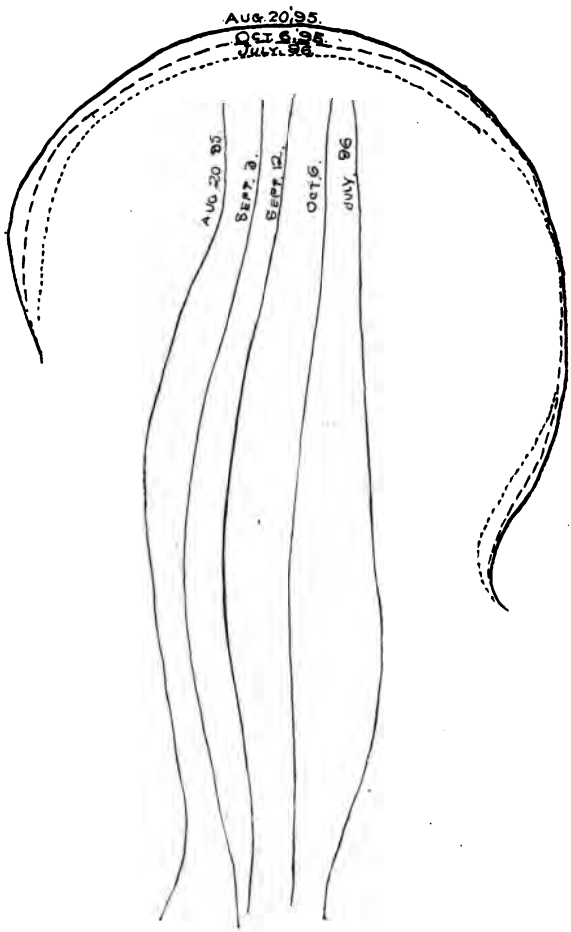



FIG. 114.

TRACINGS OF SPINE AND SKULL IN CASE 39.

gation on Infantile Scorbutus in North America, the following is found:

"In all the committee has collected 379 cases by 138 observers. The disease is most apt to develop between the ages of seven and fourteen months, inclusive. The youngest child reported was four weeks, and the oldest was nine years.

"Of 379 cases it is interesting to note that 83 per cent. occurred in private practice, and only 17 per cent. in hospital practice. There was a greater tendency for the disease to occur among the rich or well-to-do.

"The most important etiological factor, according to general opinion, is a dietetic one. The children had been fed on every variety of proprietary food, and sterilized milk, and but 10 of the 356 cases had received breast milk alone.

"The occurrence of weakness of the back, a symptom which Barlow says is marked, is mentioned as present in 97 of the cases reported to the committee and as absent in 108.

"Joints (or probably oftener about joints) involved in 165 cases. Location given in 101; viz.:

"Knees, 73; ankles, 28; wrists, 12; hand, 1; elbow, 3; shoulder, 5; hip, 6. Shafts of limbs involved in 179 cases. Location given in 123; viz: Thighs, 59; legs (below knee), 61; 'legs' (not further stated), 11; forearm, 5; upper arm, 4; 'arm,' 5; ribs, 1; scapula, 1; ilium, 1. The gross results of the answers regarding the tissues in which the swelling occurred give: swelling in soft tissues, 97; swelling, sub-periosteal, 114; swelling in both situations, 16.

"In 16 cases it is distinctly stated that the gums were entirely unaffected, while in 313 they were diseased.

"Statistics on the portian of the gums involved were not furnished sufficiently to allow of conclusions; but regarding the teeth it is to be noted that of 359 cases suitable for comparison, teeth had already appeared in 314 instances, i. e., 87.5 per cent.; while in only 45 cases, i. e., 12.5 per cent, were there no teeth.

"Relative to cutaneous hemorrhages accurate data are given in 353 cases. Of these, it is reported present in 182 and absent in 171. In 99 instances the presence of 'ecchymoses' is mentioned. In 83 'puerpuric eruption' is reported and in 37 'petechiæ.'" In 13 the nature of the lesion is not specified.

"There does not seem to be evidence as far as this investigation teaches that the association of rickets and scurvy is at all intimate.

"Cases recovering under the combined effect of change of diet, often including beef juice, and the employment of fruit juice, with or without drugs.

"The conclusions to be drawn from this combined study of etiology and of treatment seem justifiable only to the following extent:

"(1) That the development of the disease follows in each case the prolonged employment of some diet suitable to the individual child, and that often a change of diet which at first thought would seem to be unsuitable may be followed by prompt recovery.

"(2) That in spite of this fact regarding individual cases, the combined report of collected cases makes it probable that in these there were certain forms of diet which were particularly prone to be followed by the development of scurvy. First in point of numbers here are to be mentioned the various proprietary foods.

"(3) In fine, that in general the cases reported seem to indicate that the farther a food is removed in character from the natural food of a child the more likely its use is to be followed by the development of scurvy.

"Twenty-nine of the 379 cases are reported to have died. In 2 of these, death seems to have been remote from the attack of scurvy.

"It is difficult to determine in how many of these the scurvy itself could be held responsible for the death; probably in few if any.

"From a study of this report and from due consideration of other known facts, scurvy appears to be a chronic ptomaine poisoning due to the absorption of toxins.

It is most interesting to note the report of an epidemic of scurvy furnished by F. A. McGraw, of Crete, Neb. (Medicine), in which a study of forty-two cases is made. His deductions are confirmatory of the above report, except that he emphasizes uric acid as a causative factor. He does not agree with the claim made by the Italian observers Testi and Bebi that it is due to micro-organisms.

## SYPHILITIC BONE DISEASES.

**Syphilitic** lesions of bones, either hereditary or acquired, make up a great portion of all joint and bone diseases. So called tubercular diseases of children are not infrequently manifestations of inherited syphilis. This statement is verified by the rapid progress made toward recovery in cases under anti-syphilitic treatment, and the marked destruction of bone and other tissues when mechanical treatment alone is depended upon. Cases with every symptom of hip and Pott's disease have disappeared without deformity in a few months under vigorous medical treatment, along with mechanical measures. Syphilitic epiphyseitis of adults occurring during, or subsequent to an initial lesion, has been considered by Fournier under the following heads: "1. Arthralgia, or articular pains without appreciable changes. 2. Subacute arthritis resembling somewhat a mild form of rheumatism. 3. Hydrarthrosis.

1. "*Arthralgia.*" This is characterized by pain on moving the joints, although there is no appreciable change. It is simply a functional trouble and is found in almost all joints, more especially the scapulo-humeral, articulation and the knee; next in frequency the elbow, the wrist joint and the tibio-tarsal articulation, and less commonly in the joints of the hands and feet, the temporo-maxillary articulation and the hip joint. One characteristic of this affection is that the pain is as severe when the joint is at rest as when in action, and is

rather more frequently met with in women than in men. It commences at the beginning of the secondary period, and is co-incident with the macula syphilide and the general nervous and febrile disturbance. Its duration is variable, frequently disappearing spontaneously; but in many instances it may persist for several months in untreated cases. It readily and quickly yields to mercurial treatment.

2. "*Subacute Arthritis.* This is the rarest form. It is attended by great pain and disturbance of motion and the joints are slightly swollen. Sometimes even a slight exudation may occur in the joint, which may readily pass undetected. Usually one joint is affected, sometimes two, and rarely three. Almost subacute in character, it runs a febrile course. The knee is the joint which is especially attacked, the elbow, wrist joint and tibio-tarsal articulation less so. It is not observed in the small joints.

3. "*Hydrarthrosis.* This is more frequent than the subacute variety, and is distinguished from it by having less pain, by a greater exudation into the joint which, however, is never very large, and by the fact that it is never attended by fever. The seat of the affection is almost exclusively the knee joint. The subacute form and the hydrarthrosis may leave permanent changes behind, as indicated by a grating sound on moving the joint. The duration if left untreated, is long, but if treated it can be cut short. These lesions so closely resemble rheumatic affections that they are often times regarded as simple rheumatic pains developed in syphilitic subjects."

Hutchinson, of London, makes the following division of the affections: "1. Synovitis during the second-

ary stage which usually occurs within a few months of infection, is of but short duration, is very amenable to mercurial treatment, and clears off, leaving no trace behind. It is rare and of far less importance than the other forms, which all occur during the tertiary stage. 2. Peri-synovial gummata. 3. Arthritis due to osseus nodes or gummata in the neighborhood of the joint. 4. True chronic synovitis. 5. Syphilitic chondro-arthritis (Virchow)."

In the second stage, or form, effusions into the bursae or tendon sheaths are occasionally met with. Peri-synovial gummata are more common in women than men, the tissue around the knee being particularly liable to be affected. It is a frequent and very chronic form. The third form is really comparatively rare, in spite of the fact that some authors incline to place all forms of syphlitic joint disease under this head. These osseous nodes have one diagnostic symptom, viz., severe nocturnal pains. The fourth form is the common form of syphilitic arthritis. To the above 5 forms the author adds two others, as occurring in hereditary syphilis; (6) syphilitic epiphyseitis and (7) chronic effusions into joints, usually the knee, and almost always associated with interstitial keratitis.

Rasch states that the particular form of syphilitic disease known under the name of "specific chondritis or chronic hypertrophic syphilitic arthritism, is characterized partly by a circumscribed ulceration and fibrillar breaking up of the cartilage, with the formation of villous outgrowths, partly by the presence of radiating, depressed cicatrices placed in the cartilage, and partly by a diffused thickening of the synovial membrane and a marked proliferation. The lesions seem always to

invade both the synovial membrane and the cartilage. The ulceration of the cartilage depends upon gummatous infiltration. The clinical features of a case of syphilitic chondro-arthritis are said to be: diffuse soft swelling of the synovia, with slight limitation of movement; pain, which is present to a limited degree, and is not aggravated by motion. They are evidently not distinctive."

Duguet presented a case of periostitis of the temporal bone, accompanied by myositis of the temporal and masseter muscles, apparently of syphilitic origin. Fournier, commenting on this case, states that he has observed only four or five similar ones. Foulard presented a patient who suffered for two years from an enormous gammatous tumor of the left thigh. This enlargement was mistaken for one of malignant nature, and an amputation was proposed. It was later suspected that it might be syphilitic. Constitutional treatment was instituted and was followed by speedy cure.

Among those who have written on this subject are Cheminade, Rubenstein, and Trinkler. Rubenstein publishes statistics of 43 cases treated in Schuller's clinic,—1 from secondary syphilis, 26 tertiary, and 16 hereditary,—in children from 3 to 16 years of age. In 18 months Schuller saw 328 cases of joint inflammation, of which 6½ per cent. were syphilitic in origin. The capsule in syphilitic inflammation of joints often become hardened in spots, and lacks the uniform, doughy feel of tuberculosis. He also emphasizes the nocturnal pains in syphilis.

According to Lannelongue, the diagnosis from tubercular disease is to be made by observation of the facts that there is no involvement of the joint itself, and

that the swelling affects the bone in its immediate vicinity; that there is an absence of muscular contractures limiting the movements of the joint; that the enlargement of the bone is diffused and general, and that there are present other evidences of syphilis.

*Heredity* as a factor in the production of disease is well known and Dr. Gibney states that 499 out of 500 cases of hip disease give a history of tuberculosis in the immediate ancestry. Statistics do not, however, show how many of these afflicted children had syphilitic ancestry. The saying of the late Dr. Gross is well known. He concluded that the children of almost all soldiers of the rebellion had inherited syphilis. Railroaders, river men and seamen, and men of all pursuits which require them to be away from home, too frequently have syphilis. Indeed, syphilis is most common among all these classes, and the limit is not here, but it extends to miners, millworkers, and clerks, and merchants and retired citizens are too frequently the victims of later syphilitic manifestations. If these statements are correct, do you think it would be a difficult matter to find a history of syphilis in every case of Pott's, hip, or knee joint disease? Without definite data upon which to base a claim beyond that of personal experience, and that is insufficient, no claim will be made. It is the desire of the author, however. to call attention to this apparently neglected element as a cause of these diseases, and ask that these patients be given the benefit of medical treatment. The orthopedic thinks of his brace. the operator of his Volkmann spoon, and the general practitioner neglects the instrument maker for his medicaments. Treatment is only perfect, however, when there is a co-operation of the quartette.

In conclusion it would appear,

1st. That many of the cases of epiphyseitis of adults are associated with secondary syphilis, and should have proto-iodide of mercury, or with tertiary syphilis and should have iodide of potash, and that in neither condition should a knife be used.

2nd. That many of the cases of hip-joint and Pott's disease and other bone diseases of children are suffering with hereditary syphilis and should be given the iodides.

3rd. That in all cases of the so-called hip and other joint disease, iodide of potash should be given whether a specific history can be obtained or not.

## ARTHRITIS DEFORMANS.

This disease is a so-called rheumatic trouble, and has been described as rheumatoid arthritis, osteo-arthritis arthritis deformans, dry arthritis, and nodular rheumatism. It may be confined to one joint or may successsfully involve every joint in the body. From our present knowledge of these conditions it is probably sufficient to discard all names except rheumatoid arthritis, and osteo-arthritis. Goldthwaite says the true difference between the appearance of the joints in osteo-arthritis and rheumatoid arthritis, is that in the former the joints are larger than normal and characterized by spindle shaped swelling, while in rheumatoid arthritis the joints are smaller than normal, this change being due to atrophy of the epiphyses. Hugh Lane considers osteo-arthritis as a later stage of rheumatoid arthritis, differing, as may be observed, from the conclusions of Goldthwaite.

*Etiology.* The causes of rheumatoid and osteo-arthritis may be considered as predisposing and exciting. L. Dor has demonstrated to his satisfaction, by making cultures and inoculations, that arthritis deformans is due to the presence of a variety of the streptococcus pyogenes aureus, and Dr. Bannatyne advances the theory that rheumatoid arthritis is of bacterial origin. He admits that the proofs are not yet conclusive, but the theory is based on the discovery (by him, and by Chauffard and Ramon in France) of a micro-organism in the synovia and blood obtained

from rheumatoid joints and upon the fact that the affection is very favorably influenced by the administration of antiseptics, as guaiacol, carbonate of benzol, salol, etc. *Trauma* as pointed out by Goldthwaite is an important etiological faction. The injuries are usually slight, the joint receiving a slight contusion which may be forgotten until the actual joint changes begin to de-

FIG. 115.
A MUSEUM FREAK.

velop. The *Uric acid diathesis* is no doubt a great factor in its production. Some have found lesions in the spinal cord and located the cause here. Exposure to cold and peripheral irritation are considered exciting causes. The *age* at which rheumatiod arthritis is most frequent is from 40 to 50, although it may develop at any age. When it appears during adolescence it runs

a more acute course, more joints are involved, and anklyosis follows in almost every instance as the inflammatory symptoms subside. Firm ankylosis is not so likely to occur in people of advanced age, but the limitation in motion is due to the development of osteophytes and change in form of the normal joint structure. In young people the ankylosis is usually fibrous, true bony union seldom occuring. Men and women who have to work very hard have enlargement of the phalangeal joints known as Heberden's nodes. This is osteo-arthritis. It is not uncommon to see the women of an entire family have these enlarged joints, showing a dyscrasia and indicating that if these cases are not hereditary the tendency to the development of the disease is systemic.

**Pathology.** The disability is due to enlargement or degeneration of the cartilage and other joint structures. Possibly the most frequent structure involved is the cartilage, which first increases in size, but eventually degenerates and crumbles away thus exposing the bone. The synovial membrane becomes thickened. Osteophytes are formed upon the heads of the bones, which become locked and prevent motion. True ankylosis seldom occurs. Paget found a lesion of the posterior column of the cord, not suspected in life, which upon microscopic examination was found to be a proliferation of the connective tissue of the lamellar sheaths and of infra-fascicular tissue.

Goldthwaite, of Boston, in a most valuable paper concludes as follows: "Of the cases classed as rheumatoid arthritis two types are described, clinically, which for convenience are designated rheumatoid arthritis and osteo-arthritis. The differentiation between

the two types is of the utmost importance in the treatment. Rheumatoid arthritis is much more acute than the other; it occurs in middle and advanced life, but

FIG. 116.

OSTEO-ARTHRITIS.—(GOLDTHWAITE.)

early in life as well. During the acute stage the joints show a spindle shaped swelling, which finally subsides,

leaving the joints much atrophied, and usually ankylosed. For these cases the joints should be manipulated after all acute symptons have disappeared, and

FIG. 117.

RHEUMATOID ARTHRITIS.—(GOLDTHWAITE.)

the character of the manipulations is of much importance. Cases are reported showing the results of treatment in this class. Osteo-arthritis is a much more

chronic condition, occuring only in middle life or old age, and is characterized by a proliferation of the articular cartilage, with the formation of nodes about the joint. These cases should not be manipulated, as any injury or undue violence results in a more rapid development of the cartilage. It is this tendency which explains the impairment of function which so often results after comparatively simple injuries to a joint. Protection and immobilization in such cases is of importance."

**Symptoms** develop slowly in the young. The disease may be attended with more or less inflammation of the joint, with occasional accumulation of synovia in abnormal quantities, but this is seldom if ever found in osteo-arthritis of adults. *Pain* is not severe and may be wanting, and it is exaggerated by use. There is seldom sufficient constitutional symptoms to attract attention. Anemia may be present, but this condition is doubtless due more to inactivity than to actual blood lesion. Muscular atrophy is a prominent and early symptom and is always found. Bronze patches upon the skin have been observed.

**Lameness** is the most prominent and permanent condition.

**Location.** The knee is the most frequent seat of the disease, and the other joints are involved in the following order: shoulder, hip, wrist and elbow. The disease as it involves the joints of the fingers is quite common among working women during advanced life. It may be limited to one joint, or it may successively involve every joint in the body.

**Deformities** are varied and numerous. Some cases become perfectly helpless. The author has seen a case

in which every joint of the body was completely locked except one wrist and hand, with slight motion at the temporo-maxillary articulation. In the knee, the usual displacement is subluxation, due to contraction of the hamstring tendons. The head of the tibia slides backward and under the condyles of the femur. In *hip* involvement the thigh is in flexion and adduction, and occasionally the muscular contractions are so severe as to result in spontaneous dislocation. *Spinal* distortion is quite marked, and there may be anterior, posterior, or lateral flexion, or rotation. The head is frequently drawn downward with the chin on the sternum, or laterally with the ear against the shoulder, as the author has seen in one case. *Spinal ankylosis* occurs from apparently the same cause and is known as *spondylitis deformans* and rheumatism of the spine. The pathology and general course are the same as of the extremities. Differentiation must be made from Pott's disease and scoliosis.

The *elbow* becomes rigid in partial flexion. The wrist is usually flexed. The fingers may be so distorted as to be dislocated. The feet may assume any of the varieties of club-foot. The *temporo-maxillary* joint may be so limited in motion that the sufferer has to live on liquid diet, and it is with difficulty that this can be introduced between the teeth.

**Exostoses.** In certain cases not associated with the usual symptoms of arthritis deformans, small spur like processes develop from the epiphysis of long bones, which may become quite large, increase in number and present a lobulated appearance. The development may be so extensive as to destroy the joint, thus requiring their removal or excision and in some cases amputation has been necessary.

A **diagnosis** must be made between rheumatic arthritis, synovitis of traumatic, gonorrheal or syphilitic origin, and from tubercular bone and joint diseases.

**Prognosis.** It is incurable. One joint after another becomes involved until, as we have seen in Homes for Incurables and museum freaks, there is no motion in any joint of the body. Life is of course shortened, but these individuals live for years in this helpless condition. Several cases of chronic articular destruction of one joint followed by involvement of other joints, have come under my observation. In one case the trouble began as a simple synovitis of the left knee which was aspirated and put in plaster-of-Paris. As other joints became involved they did not show the same tendency to hypersecretion of synovial fluid. The patient was permitted to walk about. It was not very painful, and did not cause constitutional disturbance to speak of. In this case the hip became stiff during the year, and this was followed by involvement of other joints. This has continued for eighteen years; the patient has been in bed fifteen years, and is now unable to move a single joint in the body except the maxillary, one wrist and fingers on same hand and possibly part of the toes. The patient does not suffer much pain, and the only constitutional changes are those due to his absolute helplessness from joint stiffness. In the Homes for Incurable we see many of these cases whose condition of helplessness increases on account of ankylosis of joints, but who do not present other symptoms. The disease must not be confounded with chronic rheumatoid arthritis, which presents pain and swelling of the joint with fever.

The **treatment** of arthritis deformans consists in relieving pain by opiates, rest in bed, immobilizing the joints with plaster-of-Paris, braces and splints. Deformity must be prevented by keeping the parts in a normal position. In spinal cases plaster-of-Paris jackets should be worn until the spine is ankylosed in a straight position. Mineral waters of various compositions are of value, notably those of Carlsbad, Baden, Hot Springs of Arkansas, Mt. Clements and Londondary. General health is to be improved by tonics and nutritious foods. Massage vigorously used may encourage absorption and tend to restore mobility.

## OSTEO-ARTHROPATHIES.

Several cases of joint involvement are recorded as sequelae of pulmonary disease, notably of pneumonia and pleurisy. Dr. Kerr, of Bradford, England, records a case of pleurisy with a very slow recovery. As the lung symptoms subsided the wrists, ankles and knees became successively enlarged. The enlargement extended beyond the epiphyses into the shaft, in a uniform enlargement. A crackling sensation was imparted to the fingers which were spindle shaped with clubbed ends. The affected joints throughout the body were much enlarged. The nails are longer than normal, differing from the broad nails of acromegaly. Multiple synovitis following pneumonia is reported by Widal, of France, in which nearly every joint in the body was successively involved. Cultures made of the synovia showed pneumococci. Dr. Thayer, of Baltimore, reports some very interesting cases of this variety of deformity. He calls attention to the difference between this condition and acromegaly, and says the former is secondary to the pulmonary change while the latter is a separate disease.

The *course* is slow and the prognosis is bad, but cases of recovery are reported. When there is a specific history systemic treatment is proper. One case made a complete recovery after aspirating an empyema which was the cause.

*Typhoid lesions* of the spine are occasionally seen. Gibney reports three cases, and several other cases

have been recorded since that date. The symptoms were as follows: pain in the back, usually severe, some tenderness on pressure, rigidity, pain on flexion, especially lateral flexion, no psoas contraction when the affection is situated in the lumbar spine. In one case there was elevation of general temperature; in the other two there was none. In one case there was flexion of legs on thighs, and thighs on trunk. All cases recovered rapidly and perfectly under rest to the affected part.

It is not unusual to see typhoid lesions of joints and bones resulting in quite serious destruction of tissues and permanent deformity.

In 1889 Lamberger, reported two cases following bronchiectasis and in 1891 he reported five more similar cases; in 1896 Thayer, of John Hopkins University, reported four cases, and summarises the symptoms by stating that cases had painful enlargements of the ends of the long bones especially at the wrist joint with the club condition of the finger. The long bones of the lower extremity enlarge, especially the distal epiphyses. The nails are usually large, showing marked incurvation resembling a parrot's beak, pinkish in color and considered typical Hippocratic fingers. Other similar cases have been reported following a tubercular focus. The condition resembles deformities of acromegaly and a comparison of the symptoms already given should be made with the ones herewith tabulated.

## TRAUMATIC DEFORMITIES.

### SPRAINS.

A **sprain** is a partial dislocation, but where the bone again returns to its normal position. It may conveniently be divided into three degrees: (1st) Where there is no injury to the joint, (2nd) where the joint-bag is torn and the synovial fluid escapes into the surrounding structures, associated with which there is more or less rupture of the ligaments of the joint, and (3d) where instead of rupture of the ligament it is torn from the bone and along with it is taken a bony insertion. This is known as a sprain-facture.

Under the *first* head may be classed those simple wrenches of the joints that are so common and which attract very little attention, but get well after a few days rest and the application of domestic liniments. The gravest feature of such injuries is that they may predispose to subsequent accidents of a similar nature.

The *second* class of injuries are the most serious, and have for their sequela some of the most grave forms of joint trouble known to orthopedics. The violence necessary to produce this form of injury is variable, but ordinarily is not very great, and is generally produced in a very simple and unexpected manner. One may step down but a foot or two, and light upon a round, or turning object, and the foot turn to such a point as to lose the equilibrium, and in an instant the entire weight of the body is thrown upon the ligaments, already at great tension, and the result is a rupture of

one or more of them. This rupture may mean a simple tearing of one of the more tense ligaments, or it may mean the entire destruction of all support upon the affected side, and a rent into the synovial sac, resulting in the escape of synovia into the surrounding structures as well as the entrance of more or less serum and blood from the injured blood vessels, external to the joint, into the joint cavity. This intermingling of serum, synovia, blood, etc., produces the severe chain of symptoms—of pain, swelling, etc.—so well known to all. The limitation of motion always present in sprains is due to the tension caused by the extra transfusion and effusion of liquids in and about the joint, and to the spasm of all muscles passing, or whose tendons cross the joint. This spasm may be partly voluntary, an effort upon the part of the patient to prevent pain, and partly involuntary, because of the reflex nervous disturbance always present in any form of joint injury or disease, making the muscular spasm almost constant. This variety of sprain, if properly treated early, may be most promising, but if neglected it is the beginning of untold agony. Under the most favorable course of treatment, they predispose to subsequent accidents, and under bad or neglectful treatment the trouble, at some time, is almost sure to be repeated, many times, it may be, and with increasing severity with each recurrence. The great pain associated is due, no doubt, to the pressure made upon the nerve terminals by the over distension of the joint bag, and effusion about the joint from the lacerated venules and arterioles involved.

Under the *third* head are found those more severe and less frequent complications of sprains, viz: sprain

## OSTEO-ARTHROPATHIES.

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*Typhoid lesions* of the spine are occasionally seen. Gibney reports three cases, and several other cases

FIG. 118.

FIG. 119.

METHOD OF APPLYING ADHESIVE PLASTER FOR SPRAINS.

The exact method is immaterial so that the joint is included in the strap, and that they pass around the member obliquely, and that they do not completely encircle it. Fig. 118 and Fig. 119 show the method usually practiced by the author.

A most important form of sprain is of the *spine*. Erichsen's concussion of the spine, or railway spine, so ably opposed in Page's work upon the same subject, with the articles of Dr. Opperheim, of Berlin; Dr. Tweedy, of Dublin; M. Grasset, of Montpellier; Dr.

Jacob Wolff; Dr. P. D. Knapp, and others, embody the consideration of every conceivable phase of spinal injury and spinal neurosis with the chain of symptoms of functional paralysis, anesthesia, hyperesthesia at the seat of injury, contractures, disturbance of the visual field, irritability, sleeplessness, disturbance of intellectual facilities, etc.

We too frequently are misled by what Erichsen has said upon this subject, and after one has received an injury we overlook the fact that owing to the manner of reception of the same, it would be impossible to injure the spinal cord, because of its bony protection in the vertebra, thick soft parts, and the arachnoid fluid to ward off vibratory impulses so constantly imparted to the body.

These concussions of the spine are nothing more or less than a sprain of the spinal column, either in the intervertebral articulations or articulations between the lateral processes, or even those between the ribs and vertebrae, with a contusion of the interposed synovial membrane, as is the case in other joints, a rupture of the joint bag, or ligaments that enter into the formation of the spinal column, so numerous and complex. The *treatment* for railway spine, produced, as Erichsen says by sudden twists or jerks, as would be the case in railway collisions, is the early application of a plaster-of-Paris or leather support. This should be done at once, or just as soon as material can be obtained for the purpose, and allowed to remain a week or two, or as long as the case appears to demand the support. Of course, the Sayre tripod should be used in applying the jacket.

## OLD UNREDUCED DISLOCATIONS.

In *unreduced* dislocations the normal relationship of the articular surfaces are changed, becoming greater as reduction is postponed, so that in months the normal joint socket may be completely filled by plastic material or destroyed by nonuse and absorption, and a fairly useful socket is not infrequently formed about the head of the bone in its new position. In unreduced dislocations the motion must necessarily be limited, and muscles and nerves are injured or pressed upon, and atrophy and impairment of function of the joint is the result. In an article on "*Reduction of Longstanding Dislocations of the Shoulder*," Dr. J. Finckh, reports 100 cases treated in the Tubingen clinic extending over a considerable period of time. The period elapsing between receipt of the injury and inauguration of treatment varied from three weeks to seven years. In a number of cases the deformity was attended with such a satisfactory result that intervention appeared unnecessary. With regard to the irreducible cases, only two were met in the first four weeks, and these were complicated by fractures. The oldest dislocations that were reduced were respectively in twelve and a half and fourteenth week, two to three weeks, twenty dislocations, 19 or 95 per cent., three to six weeks, twenty-four dislocations, 20 or 83 per cent., six to nine weeks, eleven dislocations, 7 or 64 per cent., in all 84 per cent. reduced. If complications of any kind were absent, the prognosis of dislocations of the shoulder of

two to four weeks duration is absolutely good. Up to nine weeks quite good, as up to that time, four-fifths of them can be reduced. Beyond nine weeks reduction by bloodless methods must not be the exception.

In brief histories of these hundred cases, it shows that only three were subjected to operative procedures. In one the head of the humerus was resected as a primary measure, while in the two others it was resected by a secondary operation. The functional results after resection were apparently quite good.

Thiery, of Paris, prefers an open arthrotomy, to be followed, if necessary, by resection, to subcutaneous division of bands and tendons. Pearce, Gould and Cheyne, of London, reported each one case of reduction by open incision. In Gould's case the dislocation has existed fourteen months; in Cheyne's, four months.

Dubrueilh, of Montpellier, reports a case of recurrent (five times in twelve weeks) dislocation of shoulder cured by six injections of two drops each of a 10-per cent., solution of chloride of zinc into the periarticular tissues close by the capsule. The six injections were made in the course of a fortnight, and the patient was dismissed, apparently cured, a fortnight later.

Stimson states that a man, twenty-one years old who two years before, had sustained a traumatic dislocation of the left shoulder, and in eighteen months subsequent to this the joint was dislocated by slight movements fourteen times, the last one taking place the night before an operation for relief of the condition was performed. The joint was exposed by an incision along the anterior margin of the deltoid and another running outward from the centre of the first; the anterior portion of the deltoid was detached from the acromion

and reflected. The joint was then opened to ascertain the condition of the glenoid fossa, and this being found uninjured the opening was closed and the capsule narrowed about an inch in front making a fold in it, the fold being held by two or three silk sutures, according to the plan suggested by Richard and practiced also in habitual dislocation of the patella. The wound healed without any complication, and the patient has thus far had no recurence of his trouble, and is able to use the joint as freely as the other.

Bartha reports a successful case of operative reduction of a four-months-old dislocation of the hip. Vantrin, of Nancy, reports a case in which he excised the head and neck of the femur, after failure to reduce; and Hughes a case of extreme supra-public dislocation in which excision of the head and neck was done after an unexplained delay in treatment, which had allowed so much new bone to be formed by the stripped-up periosteum that reduction was impossible.

Dr. J. S. Pyle and the author, after unsuccessful attempts at reduction of a dislocated hip, excised the head of the femur. The remaining portion of the neck was readily returned into the acetabulum, the capsule sutured and the patient made an eventual recovery, with a very serviceable limb.

Harris, of Chicago, reports a case of dorsal dislocation of the hip, of four months standing, in which unsuccessful attempts at reduction had been practiced. He operated by open incision, cleaned out the acetabulum, which was full of new connective tissue, and removed a loose piece of bone which had been detached from the posterior wall of the acetabulum; the latter seeming too small to allow reduction of the head, he

enlarged it with gouge and mallet. The head of the bone entered the acetabulum with difficulty. The wound was partly stitched and partly packed. In three months the patient could walk without a cane and without pain, free motions in all directions becoming greater daily. The author has collected twenty-six cases of old, irreducible dislocations of the hip in which operations of one sort or another have been performed. The conclusions at which he has arrived are as follows: (1) that, owing to the danger of fracturing the neck of the femur, lacerating the great vessels of the thigh, producing shock and death, the application of great force to reduce old dislocations of the hip should be discontinued in favor of arthrotomy; (2) that subcutaneous operations in old dislocations are without benefit; (3) that osteotomy below the trochanter could scarcely come into consideration at this day; (4) that resection is only to be thought of when reduction by arthrotomy fails; and final, (5) that the operation which has given the best results is free arthrotomy, with reduction after the method described.

Drs. Burell and Lovett (*American Journal of Medical Sciences*, August 97) report six cases of recurrent dislocation of the shoulder upon which open operation was performed. Their conclusions are as follows:— "The treatment of recurrent dislocations of the shoulder-joint should be by massage and exercise, combined with primary fixation. If this fails after ten weeks trial, an operation is advisable. The operation should be the exposure of the anterior part of the capsule of the joint, its partial resection, and shortening by sutures."

## SPONTANEOUS DISLOCATION.

Hartman, of Paris, gives the history of a case of spontaneous dislocation of the hip, occuring in a girl 18 years old, during an acute arthritis of the hip-joint. After the dislocation had lasted one month it was reduced by manipulation under anaesthesia by Bigelow's method, and kept in place by a side-splint and extension. In a month's time the dressings were removed and massage given, and in two months the patient left the hospital, walking without a cane.

As the subject of spontaneous or pathological dislocations the hip has recently received considerable attention, it will be well to note three cases reported during the present year. One by Lannelongue the result of a suppurative arthritis following diphtheria and erysipelas; a second by Pickering Pick, double, the result of pyaemic synovitis, of which one was forward, the other dorsal, and both treated a year later by osteotomy; and the third by Deviliers, a compound dorsal dislocation, the result of a deep slough of the buttock following typhoid fever.

Karewski records the following interesting case of "*Spontaneous Luxation of the Hip Joint after Gonorrheal Coxitis.*" (Ctrlbl. f. Chir., No. 38, 1891). A woman, forty-one years old, after an attack of gonorrhea was siezed with great pain in the left hip, and was treated with poultices, powders, and rest. Finally the thigh became flexed, and the knee rotated outward and abducted. Six months later she came under the obser-

vation of Dr. Karewski, who found the left lower limb two inches shorter than the opposite one, the trochanter much elevated, and the soft parts wasted. Motion was so painful that the patient had to be anesthetized for further examination, and it was then found that the head of the femur had been dislocated from the acetabulum. The diagnosis was thus made of a spontaneous luxation resulting from an acute monarthritis, due to great effusion into the joint and the faulty position in which the limb had been allowed to remain. Reposition of the head of the bone was impossible, and no improvement could be expected from extension, so excision was performed. The head of the femur was found dislocated beyond the upper margin of the acetabulum, the ligamentum teres was gone, the acetabular cavity was filled with a mass of succulent connective tissues, and most of the articular cartilage was destroyed. The patient made a good recovery.

## UNUNITED FRACTURE.

*Ununited Fracture.* When a fracture does not unite promptly it is known as delayed union, which after the course of six weeks or two months may show evidence of union and eventually becomes solid. Certain fractures on the other hand remain ununited indefinitely.

*Causes*, which may interfere with the normal process of repair are general constitutional depravity, following acute sickness, exhaustion from homorrhage, or deficient nutrition to the bone from local causes, diseases of the bone and blood vessels, non-adjustment of the fragments, or the intervention of soft structures between the ends of the fragments. Non-union occurs in individual bones in the following order : humerus, tibia, femur, radius and ulna. Non-union occurs once in about five-hundred fractures. Causes which may also interfere with union is medlesome doctors who are not sure whether the bones were properly adjusted at the time of the accident and curiously removed dressings frequently to inspect, and so doing, jostle the ends of the bones. The bandgages may be to tight, interfering with the circulation to the parts, or they may be to loose allowing mobility, both causing non-union. In cases of non-union the ends of the bones become round, and the medulary canal is closed, and the ends may be separated. Atrophy of the soft parts is generally found.

*Treatment* consists in stimulating the circulation to

the parts, and irritating the seat of the fracture. Nicholaysen, of Christiana, introduces a number of sewing needles, between the fragments and allows them to remain for half an hour, repeating the procedure every two or three weeks. This gave him good results. Prof. Berg, of Stockholm, uses hypodermic injections of Chlorids of Zinc with success. Brainard's method of boring the ends of the bones will in some cases excite the deposit of reparative material and result in union. All of these operations are done subcutaneously and must be carried out under strict antisepsis.

*Open operation.* In all cases standing for six months or more, the only method which promises union is by

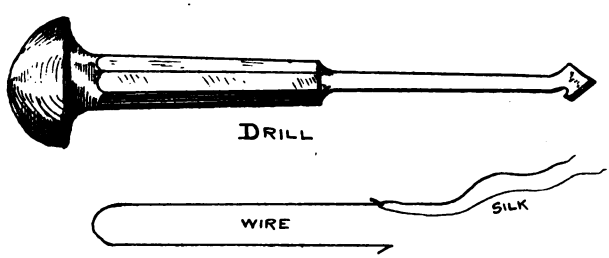



FIG. 120.

cutting down on the fracture, freshen the ends of the bones by sawing or otherwise, and secure them by one of the various methods. For this purpose, nails, ivory pegs, kangaroo tendon, and wire have been used. To the author's notion the latter method is the one *par excellence* which under every condition positively secures temporary adjustment of the fragments, resulting in union, when this is possible.

To Dr. Wm. F. Fluhrer, of New York, must be given

the credit for perfecting instruments for *bone wiring*. In order that this might be speedily done it is necessary to use a notched or perforated drill. It is an easy matter to pass a drill through a bone, but it is not such an easy matter to keep the drill hole pervious or reenter again after the drill has once been withdrawn.

As will be observed (see Fig. 120) the drill is notched near the point. After it passes through the bone a silk

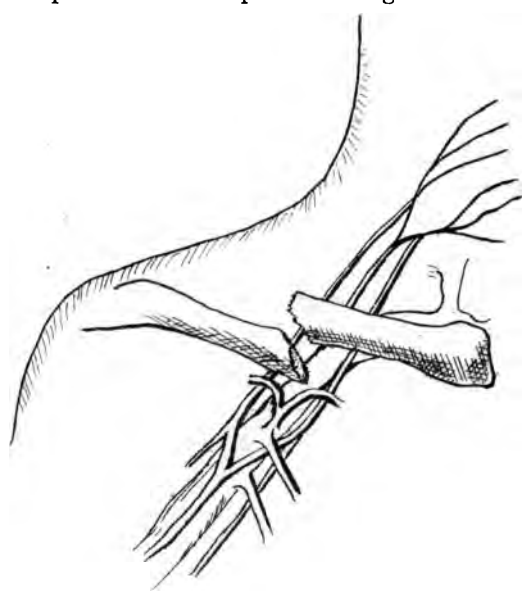


FIG. 121.

FRACTURED CLAVICLE.

thread is thrown around the point and allowed to engage in the notch, after which it is withdrawn. The drill hole once loaded with silk, the wire is attached and drawn through either way as desired.

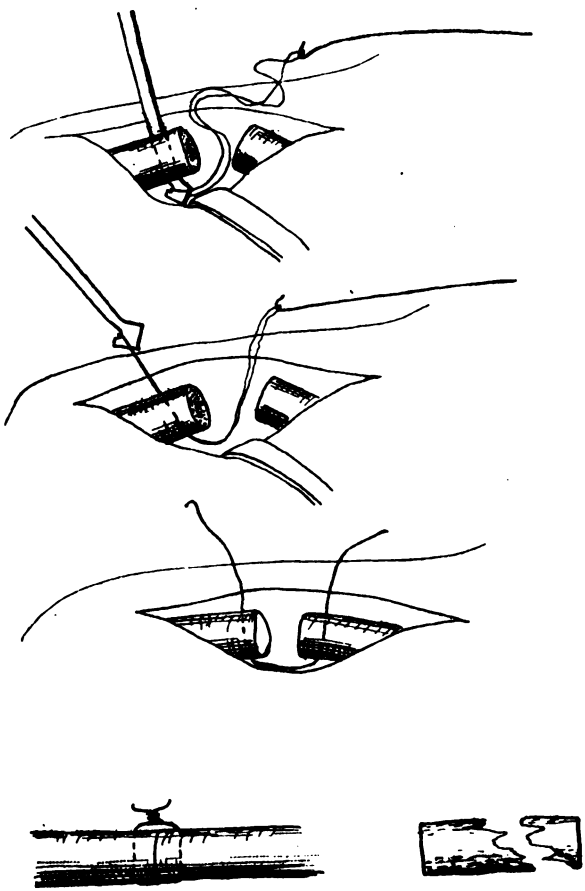


FIG. 122.

METHOD OF WIRING; AND FRAGMENT REMOVED IN CASE 40.

(*Journal American Medical Association.*)

CASE 40. Mr. P. F., aged 35, was thrown from a carriage and received a dislocation of the left shoulder and fracture of the clavicle After reduction of the dislocation the shoulder recovered promptly. The displacement of the fragments in the fractured clavicle were so great that no effort was made by nature to repair the injury. About six months after the original injury he was again injured and the shoulder was dislocated. The ununited fracture of the clavicle was more or less disturbed.

The fracture was painful at all times when the arm or shoulder was moved. The internal end of the external fragment appeared to be sharp and the patient, if he had the power in the arm, could not work on account of the pain caused by the motion.

A study of the anatomy of the parts (Fig. 121) shows that the free end of the under fragment was pushed down on the tissues over lying the subclavian artery and brachial plexus, when even the arm was elevated. Operative interference was advised for two reasons: 1st, that union of the bones might be secured, and 2nd, that the pain caused by the projecting end of the bone might be relieved.

Operation: Free longitudinal incision was made along the clavicle and the ends were dissected out. The ends were sawed off by the use of a chain saw. The bones were drilled and brought together with silver wire.

Result: Union was perfect, and the wound healed without suppuration. The arm is practically as good as before the injury. The wire was subsequently removed.

CASE 41. H. B., aged 30, brakeman, received an injury of his left thumb while making a coupling. The muscles of the palmar surface of the thumb were squeezed through the skin, and the bone was broken; the thumb was practically torn off. Preparation was made to amputate. While my assistant was anesthetizing the patient, it occurred to me that wiring might save the thumb, and the latter operation was done. In six weeks the wound had entirely healed, and in three months the

thumb was as well as the extensive laceration of the muscles would permit.

CASE 42. D. W. C., aged 37 years. The contents of a shotgun had passed through the arm internally to the thickest portion of the biceps and making its exit near the insertion of the del-

FIG. 123.

*Journal American Medical Association.*

toid. The humerus was entirely torn off; the patient favored amputation at my first visit, but we concluded to adjust the fracture and wait for results. The bones showed no signs of union, and the case was complicated by a severe hemorrhage three weeks after the injury, and at this time the patient insisted upon amputation. He was assured that amputation was not demanded, but instead excision and wiring was advised which operation was done, at this time. Two inches of bone were removed (Fig. 124), and the bones adjusted the wired. The ends of the bone were ragged and showed no

FIG. 124. —FRAGMENT REMOVED IN CASE 42.

evidence of repair. The case from the date of wiring did not have an unfavorable symptom, and in six weeks was entirely healed. The man is a farmer and has made a full hand at every kind of work ever since. The two inches of shortening did not interfere with this in the least. (See Fig. 123.)

Fig. 120 shows notched drill, the wire and silk and the method of attaching them. Fig. 122 shows diagrammatically, the method of loading the drill hole with the wire as the drill is withdrawn, as well as other steps in wiring.

Clayton Parkhill (Denver), in the treatment of non-union in bone as well as in recent fractures, advises that the bones be held in position by means of four pins, which are screwed into the bones on either side of the fracture, and allowed to project through the flesh wound, and external to the skin; they are held in position by means of four plates, and these plates are

held together by a screw clamp. Fourteen cases are reported, and it is claimed that union took place in every instance. It is also used for fractured patella, and for intercaptular fracture of the neck of the femur in which instance one long screw is passed through the greater trochanter into the fragment. Contrary to the experience of others, he claims that these steel screws retain a firm hold in the bone until union has taken place, and that they do not cause exfoliation. His conclusions are as follows :—(1) That union has been secured in every case in which it has been used, as against 56 per cent. of cures by all mechanical means, according to the statistics of Burns and Gurlt. (2) That it is easily and accurately adjusted. (3) That it prevents both longitudinal and lateral motion between the fragments. (4) That the presence of the shafts in the bone stimulates the production of osseous tissue. (5) That nothing is left in the tissues that might reduce their vitality or lead to pain and infection. (6) That no secondary operation is necessitated.

W. H. Sherwood reports a successful case of implantation of pieces of bone taken from an animal. The patient, a man 27 years old, had broken both bones of the forearm, and the fracture had remained ununited about six months. The intermediate fibrous tissue was removed, the ends of the bone freshened, and nine pieces of a rabbit's femur, each a complete segment of the bone ¼-inch thick, were placed in the gaps and the wound closed over them. Four months later four of the pieces were removed through one of the wounds which had not wholly closed. Six months after the union was made and the man returned to work.

Sommer publishes a study of the cases of a failure of

union after fracture seen in the Zurich Clinic during seven years. 489 cases of recent fracture gave six cases of failure of union and 16 of delayed union. Eight additional cases of established failure of union were admitted. The operative treatment was by stimulation by nails or pegs and resection of the ends of bones and they were usually secured with metalic suture. He reports seven successes in 14 operations.

**Ununited Fracture of Neck of Femur.** A most troublesome and permanent deformity is that resulting from fracture of the neck of the femur, generally intercapsular, when union does not take place. The injury usually occurs in people in advanced life, and the majority are in women. Unless union does take place the individual remains a hopeless and hapless cripple the rest of his life.

The usual methods of treatment are, recumbency with Buck extension, long side splints, and many varieties of brace. A pair of crutches usually offer the only means of locomotion. It must be recalled that in intercapsular fracture the nutrition is entirely cut off from the exterior, and that the ligamentum teres if not entirely torn off, is so severely ruptured as to materially reduce the blood supply to the head of the bone. The nutrition thus withdrawn from the seat of fracture greatly diminishes the chances for repair. When the ligamentum teres is torn off union is impossible. The head remains in the joint cavity as a foreign body.

If it was removed opportunity would be afforded for union to take place between the end of the neck and the cotyloid cavity. An operation offering the most in the way of a useful limb is enucleation of the head of the bone.

**Deformity following fracture** is not uncommon. Indeed it can be truthfully stated that it is the exception that recovery occurs with a condition conforming perfectly to the normal. In Colles and Pott's fracture deformity is usual. In fracture of the neck of the femur complete helplessness of the leg is the result in the

FIG. 125.

VARIETIES OF DEFORMITY FOLLOWING FRACTURE.

majority of the cases. In fracture of the shaft of the femur shortening always results. It is almost impossible to adjust fracture of the clavicle and retain the adjustment until repair occurs. The list might be continued. It is not proper here to study the methods of prevent-

ing deformity, but rather to correct it after union has taken place, in a faulty position.

The general statement can safely be made that all varieties of angular deformity can be corrected. In many cases it is impossible to correct shortening, but the latter condition is exaggerated by the angular deformity, and when this is overcome the bone is increased in length.

Treatment consists in an osteotomy, either subcutaneously or by the open method. There is practically no danger from such an operation when antiseptic precautions are taken. Union invariably takes place and the wound heals, and the treatment is that required in a simple fracture.

Dr. Goodhue (Medical Record, Jan. 6, 1894) recommends for all deformities about the wrist joint resulting from fractures, that open operation be done, and a small section of bone be removed so as to proximate them.

Dr. Moore of Minneapolis and Dr. Kerr of Washington, D. C., recommend an open osteotomy of tibia and fibula for deformities following Pott's fracture.

## TENOPLASTIC SURGERY.

**Tenorrhaphy** may be considered under two heads: First.—Operations upon tendons in chronic deformities where an effort is made to transfer the power from the origin of one muscle to the insertion of the other, or to lengthen or shorten muscles. Second.—Those required for injury.

The first class commands our attention principally. Experimental as well as practical work has been done in this direction by Parish, Goldthwaite, Milliken, Wilson and others. These operations are performed to (1) shorten, (2) lengthen, and (3) transplant tendons.

First. The shortening of tendons is principally done for *talipes calcaneus*, or where the tendo-Achillis is found too long. It is known as Willet's operation, and consists in making an incision along this tendon, exposing it, and severing it by a V-shaped incision with the apex up. The tendon is slit from the apex upward as far as may be necessary, and the end of the lower portion carried up between the lateral halves of the upper portion and sutured. Gibney has performed this operation a number of times with success. Judson, however, argues that it is of no benefit, since the same condition which resulted in lengthening in the first instance will produce the same lengthening again, and claims that the benefit is only temporary. In this operation the sutures through the tendon include the skin. Phocas objects to the section of the tendon as above recommended. He dissects it from its sheath, transfixes

and doubles it upon itself, and sutures the folds of tendons together. See Fig. 131.

Second. Lengthening of a tendon is done by Keen by longtitudinally splitting it for 1¼ inches and cutting out on one side above, and on the other side below, which allows the halves to slide along each other. (Fig. 126) They are next sutured. They may also be lengthened as suggested by Poncet, by cutting on both edges of the tendon in a zigzag fashion. Transposition of a dog's tendon has also been practiced, but great successes are not recorded. The methods Czerny and Sporon are shown in Fig. 127 and 128. Wilson's method is shown in Fig. 129.

Third. Transportation, or tendon grafting, is transferring the tendon of one muscle, not paralyzed, to one which is. From Bradford we learn that the peroneus longus has been transplanted into the tibialis anticus and tendo-Achillis, and that the tibialis has been sutured to the extensor proprius pollicis. He also suggests that the tendon of the tibialis posticus may be transferred to the peroneal tendons. Other operations have been done, and indeed the guide to the range of this procedure is only limited by the amount of paralysis, and the use that can be made of the tendons of unparalyzed muscles. Bradford furnishes us with the accompanying illustrations (see Fig. 132); shows insertion of the cut peroneal tendons into the tendo-Achillis; transplantion of the peroneus longus to the tibialis posticus; transferrence of the posterior tibial and peroneus into the tendo-Achillis. The operation of transferring the sartorius into the rectus fomoris for paralysis has been done with success. The ligamentum patella has been shortened for slipping of the

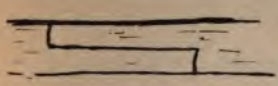



FIG. 126.—KEEN.

FIG. 127.—CZERNY.

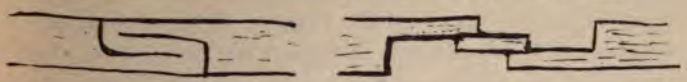


FIG. 128.—SPORON.

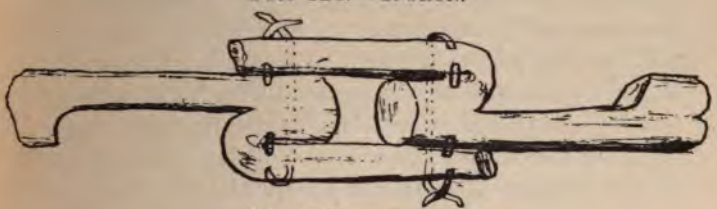


FIG. 129.—WILSON.

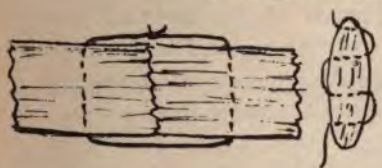


FIG. 130.—LUND.

FIG. 131.—PHOCAS.

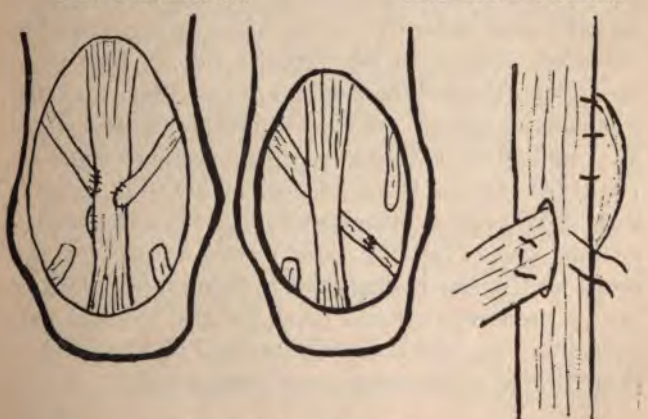


FIG. 132.—BRADFORD.

patella, by clipping off the tubercle of the tibia and nailing it farther down, or by shortening it by one of the above named methods. In one case of *talipes calcaneo-valgus paralytica*, in the practice of the author, the tendon of the peronous brevis, was sutured to the tendon of the tibialis anticus. An incision was made in front of the ankle over the tendon of the peroneus brevis, and after exposure it was severed from its insertion into the base of the fifth metatarsal. The tendon of the tibialis anticus was located through this incision and a probe passed down along its sheath and an opening made into the same over the navicular. The tendon of the peroneus brevis was now withdrawn from its new sheath and carried down along the tibialis anticus by means of an eyed probe to the point of incision where it was secured by sutures. But three small incisions, one of which is subcutaneous, are necessary in this method, thus avoiding extensive incisions and resultant scars.

Tendons may be elongated by first cutting half way through them from the edge then longitudinally splitting the same as far as may be desired when the cut is extended through to the opposite side. This allows the split portions of the tendon to slide upon each other. The ends thus made are sutured and the wound closed. The method of suturing is of importance, since the vitality of tendons is not as good as that of other structures. When the sutures are so inserted as to strangulate the stump beyond their insertions, necrosis will result and union is likely not to take place. This being the case some method must be used to avoid such a result. FIG. 130 shows the method of Lund, which theoretically would appear quite acceptable.

RUPTURE OF QUADRICEPS EXTENSOR FEMORIS.

Rupture of the tendon of the *quadriceps extensor femoris*, or the patellar tendon may occur, destroying the power to extend the leg. While the accident no doubt occurs more frequently, only 255 cases, upon which operation has been done, have been recorded. Walker records these cases as follows: Quadriceps 144, patellar 141. The rupture may occur in the muscle, the tendon or through the bone in the form of a fracture.

Buchanan, of Pittsburg, in his paper records 36 cases, giving the nature of the injury, history of cases, method of operative procedure and results, and reports one case upon which he operated with practically a perfect result. The 36 cases reported by Buchanan are included in Walkers 255 cases.

*Sex* is not a factor; the *age* is usually over fifty, and the accident occurs about equally on each side. It most frequently results from a misstep or fall. Indirect violence or muscular contraction produces more ruptures than direct violence.

The *symptoms* are lack of power to extend the leg, following trauma or a fall, swelling, and an extended gap in the tendon as found upon digital examination. The amount of separation depends upon whether the rupture is complete or partial. In complete rupture the separation is sufficient to permit a finger to be dropped into the depression. Symptoms in rupture of the ligamentum patella do not differ greatly from ruptures above this structure. The rupture is generally complete, so that the separation and consequent depression are always marked.

*Treatment* of rupture of the quadriceps or patellar tendon is suturing by the open method, which consists

in making an incision directly across the knee, or, as Buchanan suggests, directly over the tendon and parallel to it. The second step is to freshen the ends of the ruptured tendon with a curette. The tendens are now brought together with two or three strong sutures, inserted well back in the tendon, after which the margins are adjusted with fine catgut. The synovial sac should also be closed with fine catgut sutures. During the course of the operation it will be well to place a fold of gauze under the field of operation to prevent the blood from gravitating into the joint cavity.

As suture material, catgut, kangaroo tendon and silk worm gut are used with success. Even when the rupture is so close to the patella that this bone has to be drilled, these materials may be used in preference to silver wire, and Buchanan used silk worm gut in such a case.

The author desires to report a case of rupture of the quadriceps in addition to the cases tabulated by Walker.

CASE 43. R. T. M., aged 50, who had an atrophied left leg, with ankylosis of knee at an angle of 50, was walking when he slipped and fell, at which time he heard a distinct snap. His attending physician placed the leg in extension with bandages to relax the thigh muscles and a figure of 8 bandage to hold the patella in position. In five weeks he was trying to walk with crutches when he again fell, producing a complete rupture of the ligament as well as tearing loose any adhesions which may have been formed.

Upon examination, five and one half weeks after the date of the accident, it was quite evident that a complete rupture of the quadriceps existed, as there was a distinct gap about the breadth of a finger and quite as deep. An operation was advised, the same being done one week thereafter.

Operation consisted in a transverse section of the skin immediately over the ruptured tendons into the joint cavity.

They were found separated at least an inch. The rupture was directly across the tendon the edges being well defined. Gauze was placed under the knee cap over the articulation to prevent the entrance of blood and detritus during the operation. The rupture was about one-half inch above the patella, which left sufficient tendon to hold the sutures, thus avoiding the necessity of drilling this bone. For the heavy sutures two kangaroo tendons were used. The ends of the tendons were found practically healed over, and required thorough curettement, after which they were easily adjusted. Before bringing them together, however, several fine catgut sutures were inserted along the lower edge of the tendons so as to make a complete approximation of the joint bag at all points. The tendons were now adjusted, and fine catgut used to completely adjust the cut edges of the synovial membrane on both sides of the tendon. A small rubber drainage tube was used, which was removed on the third day. The patient made an uneventful recovery; went home in four weeks, is now working, and can walk with a cane in spite of the helpless condition of the other leg. Extension is complete, and flexion is to a right angle.

**Cicatrices** resulting from burns as they may be found about the face and neck and across joints, form a class of deformities most difficult to manage, requiring skill, ingenuity and patience on the part of the surgeon, and endurance and faith upon the part of the patient. In cases where skin flaps can be transplanted from neighboring parts the operation is simplified, but when this is not the case, skin drafting, either multiple, from some other part of the body or transplants or grafts from foreign sources is the usual method of procedure. The prime object is to preserve tissue. In no instance should any portion of the cicatrical band be removed. The bands should be so severed as to permit their sliding upon themselves, or they should be permitted to gap where a skin flap can be adjusted.

For bands across joints as the elbow or neck, or of

fingers the author makes an incision along the crest of the band from end to end. Care being taken to separate the two layers. Cuts are made at both ends of the first, but on opposite sides back to the edges of the cicatrix, as shown in Fig. 133 A. The angles of the flaps thus made are dissected back for a short distance. As the joint is extended, traction is made on the skin

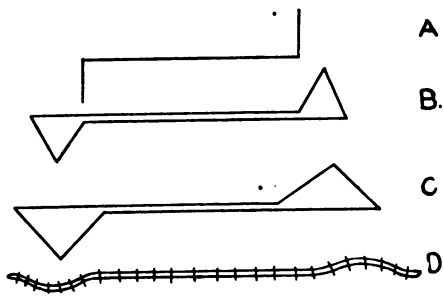



FIG. 133.

METHOD OF PRESERVING TISSUE IN PLASTIC OPERATIONS.

at the ends and a condition as shown in B results, and as result of further traction, conditions are shown in C. The margins of the flaps made by the longitudinal cut, slide upon each other while the end incisions are almost obliterated by the extension. The flaps are liberated as may be necessary to permit complete extension. The edges of the skin, or cicatrical tissue as it may be, are brought together and satured, D.—This may not be possible near the ends, but in the center it is usually not difficult. The advantage in this method of operation is that it furnishes covering for the central portion of the cicatrix where it is most needed, and if an uncovered portion is left it is near the ends where flaps from neighboring healthy tissues may be switched about to cover them.

## CONGENITAL DISLOCATION OF THE HIP.

**Congenital Dislocation** of the hip, properly speaking, is a congenital displacement due to a lack of development of the acetabulum, ligaments or femur.

**Frequency.** In 5432 orthopedic cases, 34 had congenital dislocation. It is a rare condition, occurring possibly in one in every 20,000 births. 85 per cent. are in girls and 15 per cent. in boys.

**Etiology.** The causes which have been advanced may be summed up under four heads, viz.: 1st, heredity; 2nd, mechanical; 3rd, developmental, and 4th, pathological.

1. Hereditary history has been traced by French and English writers, and Dupuytren reports a case who had eight relatives with the same deformity.

2. The mechanical causes are (a) deficient liquor amni, and malposition in uteri; (b) unskillful delivery of a child in breech presentation; (c) falls of the mother during gestation.

3. The development causes are premature ossification or arrest of development of the cartilage, or arrest of development of the acetabulum, the illy developed acetabulum resulting in a shallow cotyloid cavity.

4. The pathological causes are, morbid conditions in the joint; prenatal diseases, as tuberculosis, synovitis, etc.; muscular contraction, or paralysis due to some prenatal lesion of the central nervous system.

**Pathological Anatomy.** These displacements are generally incomplete before the child walks, but become

complete soon after. The most usual position of the head of the femur is on the dorsum of the ilium, and it is quite rarely found on the pubis or in the obturator foramen. The acetabulum and cotyloid ligament are not fully developed. The cavity is shallow or absent. The cartilage may be deposited on the surface of the iliac bone under the head instead of in the cotyloid cavity. The head of the femur is ill shaped, the neck is short and the angle is more acute. The ligamentum teres may be attached, but is flat and longer than normal. The capsule is stretched thin and may be distended with fluid. Some muscles are elongated, while others are shortened or displaced, and are not so well developed. As the child begins to walk the foregoing conditions are exaggerated. Nature makes an effort to build a new acetabulum about the head of the femur in the abnormal position. The tissues about the joint become dense and even cartilaginous. The head of the femur is absorbed, the neck shortened, and it may shift its bearing as a result of the change of position of the body as adult life is reached, due to the change of attitude, from occupation, etc. In adult life there is a still further exaggeration of the lax conditions of the capsular muscles and ligaments. The head of the femur may travel well up on the external surface of the ilium, the muscles being correspondingly displaced. The spine is in lordosis caused by the patient's effort to retain a stable equilibrium. The pelvis changes its shape. The ischiatic tuberosities are separated and the iliac crests approximated, due to the pressure of the femoral heads upon the ilia. A bilateral deformity is found in a certain per centage of cases.

**Symptoms.** The trochanter is above Nelaton's line,

and in walking there is a waddling gait with the pelvis in lordosis with prominence of the abdomen. Lordosis disappears during recumbency. The feet are generally flat and turned out, and the knees are brought together. There is no pain to speak of, although there is more danger of spraining the imperfect joint, resulting in the usual symptoms. The extremity is actually shorter, as is shown by measurement, and a flail-like condition is found at the joint.

**Diagnosis.** If the greater trochanter is above Nelaton's line, and no history of trauma or pathological changes are found, it is safe to conclude that it is a case of congenital dislocation of the hip. A further examination will show that the head of the femur is above the acetabulum, the joint is flail-like, the knees are close together, the heels are turned in, and the toes are turned out. Traction upon the leg will draw it down and thus increases its length. Atrophy of the muscles does not exist. The waddling walk is found, and in bilateral cases it is increased. The prominence over the hip will be found in well defined cases. In some mild cases of partial dislocation, the symptoms are rather obscure and diagnosis is difficult.

**Differential diagnosis** must be made from infantile spinal paralysis, bow-leg and *coxa vera*. History of *the case* along with examination and measurement will lead one to make a correct diagnosis.

**Prognosis** depends upon the degree of displacement and the age at which treatment is instituted. Cases with little displacement, seen early before walking is begun, can be greatly benefited. When the displacement is great in adult life, treatment will do little good. In other words mild cases when seen early can be bene-

fited. The prognosis also depends upon the extent of deformity of the acetabulum. Restoration to a normal position is the exception. Improvement only is a general result.

**Treatment** is subdivided into : 1st, reduction by apparatus ; 2nd, reduction by force, and 3rd, reduction by operation.

FIG. 134.

DOUBLE CONGENITAL DISLOCATION OF THE HIP.

The first method has been in vogue for years, and the appliances are almost innumerable. The couches of Adams and Buckminster Brown, the trolley of Bradford, and the right angle extension frame as used by Bradford, may be used with benefit. Traction in recumbency continued for years has cured cases. Plaster-of-Paris jackets and corsets have been advocated by the Germans. The ordinary long traction hip splint is probably the best method of making traction since definite

amount of traction can be made, and the patient be permitted to walk about. Phelps uses a pelvic band which is made broad enough on the affected side to extend well over the trochanter. Pressure is made downward and inward upon the trochanter by means of a screw, the end of which is padded and which passes through the projecting portion of the pelvic band. The pelvic band is held down in position by perineal straps.

Forcible reduction consists in making reduction under an anesthetic. This procedure may be tried in all cases, before operation. It may be found beneficial and is attended with no dangers under ordinary force.

Paci's method of treatment consists in forcibly manipulating the limb as if to reduce a traumatic dislocation; that is, the limb is first forcibly flexed as far as possible, then adducted, then rotated outward, then extended; afterward the thigh is held completely extended and immobilized, and traction is applied. If the shortening is not completely overcome at the first operation a subsequent one will probably accomplish the reduction. In about two months the plaster-of-Paris splint is removed and an extension apparatus applied. About four months after the operation the patient is allowed to get up and walk with crutches. At night extension is reapplied. The limb is massaged daily, and once a day receives electrical treatment. The treatment to be adopted will depend a good deal upon the age of the patient.

Hoffa says his operation should not be done on patients over ten years old. Lorenz has operated on a girl twenty years old, but advises early interference. Kermisson considers the best age between four and six. Paci's and Schede's methods may be applied a few days

after birth, the earlier the better. Paci has also reported good results from children in their teens. Post, of Boston, is pleased with the method. Lorenz, one of the pioneers of the operative treatment, has tested this method and has used it in thirteen cases since 1895. Ridard treated five cases and achieved success in three. The bone cannot always be returned to the acetabulum but it is made to more nearly conform to the normal location and it is held there for a year or so, either by a couch in recumbency, or by an ambulatory hip brace, until plastic adhesions have formed about the head of the bone.

**Operative treatment** is the method of the day and to Hoffa is due the credit of perfecting the technique. Various operations have been done. The aim in them all is to increase the size of the acetabulum and return the head of the femur, even if its size has not been reduced. Margary removed the head of the femur, and many surgeons have followed him and modified his method. Hoffa's operation is done as follows: Open the joint by a posterior (Langenbeck) incision. The capsule is now divided at its attachment to the neck of the femur. With a periosteal elevator the muscles are pulled from the greater trochanter. Flex the thigh and by pressure upon the head push it into the old acetabulum when the leg is extended. In children over six the muscles which have their origin on the tuber ischii, as well as the rectus and adductors, are to be cut. The acetabulum is enlarged by a Volkmann spoon, and the head of the femur is reduced. The limb is adducted, fixed and extended and allowed to remain for four or five weeks. A traction hip splint is worn continuously for months or until consolidation takes place.

Lorenz operation is not so dangerous and to be preferred. It is divided into three stages. First, formation of the head; second, reduction of the head by severing resisting muscles and tissue, and third, enlargement of the acetabulum and fixing it in position. Lorenz says the muscles attached to the trochanter are lengthened, and not shortened, according to Hoffa, and do not require section. He cuts the fascia lata, tensor vaginae femoris, hamstrings, and part of the adductor magnus. The limb is fixed in slight adduction, and left for four weeks. Massage and gymnastics are begun at this time, with the limb in a traction brace. Hoffa has operated upon 177 cases, with six deaths, and Lorenz 63 with one death. Tubby says: (a) The number of perfect cures by operations is small. (b) Cases are, however, frequently benefited. (c) Lameness persists to a slight degree. (d) The formation of a complete new joint is very rare. (e) The lordosis is generally corrected. (f) The danger from Hoffa's operation is considerable, and a complete cure is problematical. Delaney in his recent work concludes by saying (regarding results from operation) that there usually remains shortening, but afterward the joint tends to improve; that endurance is increased and pain less, but patients must wear braces and wait for a year or so to appreciate the full benefit of the operation.

Bradford, in his excellent paper on this subject, concludes as follows: (1) The methods of treatment by traction, or by mechanical means, crutches, splints, recumbent traction, with or without tenotomy, do not effect a cure; (2) correction by means of forcible reduction without incision can be applicable in but few cases, and is not reliable; (3) the methods of

operative reduction offers the best prospects of cure. The method however involves risk, and is not certain in its result, but it is to be expected that further experience will give greater precision and more certain results, as no inherent difficulty lies in the way of operation; the condition of the shortening of the muscles, the shortened condition of the anterior bands of the capsular ligament (described by Bigelow as the Y ligament), form an important obstacle to complete reduction, and these fibres should be thoroughly divided. It is also the opinion of the writer that these fibres can be more thoroughly divided by incising them from in front than from behind.

## CONGENITAL ABSENCE OF PATELLA.

Mr. E. Muirhead Little of National Orthopedic Hospital, (London), reports 42 cases of congenital absence of the patella. They are associated with hyperextension of the knee with limited flexion. The hyperextension varies from a few degrees to subluxation, or even to anterior dislocation. Occasionally the knee is partially ankylosed. Talipes is a frequent associated condition.

Twenty one of the 42 cases had club foot; sixteen of which were varus. Other defects are frequent associated conditions, as absence of fibula, tibia, dislocation of hip, spina bifida, etc.

In nine cases the patella appeared at times, varying from six months to six years. In four other cases, it appeared before maturity, and in the remaining twenty-six cases it did not appear at time of last examination. In twenty-two cases it was bilateral; in eleven on left side, seven on right, and two not stated.

Treatment consists in forcibly straightening the joint, even to the rupturing of capsula retaining it in a normal position with plaster-of-Paris or a suitable brace, until repair takes place; after which, a stop joint brace should be worn for some months. The result is usually quite satisfactory.

## CONGENITAL DEFORMITIES OF THE THORAX.

**Congenital deformities** of the chest are not very frequently seen. Defects in the sternum as absence of the xiphoid cartilage and cleft of the sternum are most frequent. With this is generally associated a pigeon breast deformity, which may be on one side only. They are classified as deformities of the (1) sternum, (2) rib, (3) eartilage, and one or all may be defective. The *sternum* may be horse shoe in shape, the cleft extending from the xiphoid, through the gladiolus to the manubrium. The writer recently examined a case of this kind. The bulging of the costal cartilage is an associated condition. There may be an additional *rib* below or above, or there may be absence of one or there may be a fusion of two forming the "bicipital rib." The cartilage may be defective leaving a chasm between the rib and sternum.

The **treatment** consists in protecting the important structures beneath by a pressure pad, and to make such correction of pigeon breast deformity by manual force, frequently applied as may be necessary, and where lateral curvature of the spine results, the muscles be developed by gymnastics, or if the curvature is growing progressively worse, some retaining apparatus should be adjusted.

**Acquired** deformities of the thorax other than those found in Pott's disease and lateral curvature and rickets are those resulting from obstruction of the air passage,

due to the presence of adenoids, or other post-nasal obstruction, and curvatures from empyema already referred to. Deformity also results from necrosis of the sternum and ribs, and from the removal of ribs for empyema.

The removal of adenoids or the cause of destruction will make conditions favorable for the correction of the deformity. This may be done by nature alone, but when the deformity is marked, it should receive manual correction.

## SPINA BIFIDA.

**Spina Bifida** is a congenital defect of the arches of one or more of the vertebræ, associated with which is found an absence of the integument and other structures about the spinous process, leaving as a covering of the sac the meninges, which communicate with the sub-arachnoid space which is filled with spinal fluid.

The treatment has formerly been pressure, which afforded temporary relief, but was of no permanent value. Later aspiration of the cerebro-spinal fluid with injections of iodine, carbolic acid, etc., was practiced, and many cures were recorded, notibly by McCullough, of Dublin.

The most satisfactory method of treatment is by excision of the sac, as directed by Mayo Robson, of Leeds.

CASE 45. Aged three months, of Russian Hebrew parentage. As may be seen from the illustration, there is spina bifida with a large sac, associated with which there is double talipes calcaneo-varus. The appeal of the parents, as well as the utter helplessness of the patient, present as well as future, so touched the heart that an operation was decided upon, with the understanding that it was likely to result unfavorably.

The first operation was directed toward the removal of the sac and a correction of the cord defect, with a subsequent operation to correct the distortion of the feet.

*Operation.*—The sac was punctured so as to permit the escape of the fluid slowly and thus reduce the shock to the brain. The sac was opened and a number of fibres of the spinal cord were

found deflected over the inside of it and passing through it in a spider-web fashion. These were carefully dissected from the dural layer, but it was impossible to return them to the spinal canal; they were tied with catgut close down to the opening, the loop left external to the ligature removed, and the fibres allowed to return to the spinal canal. The sac was now dissected from the surrounding tissue and cut away, except just enough

FIG. 135.

to reach across the spinal opening, this being sutured with fine catgut. The skin flap, which was not quite sufficient to reach across the muscles. The wound was drained and closed. The patient rallied from the anesthetic and did well for some days. The wound was free from infection, but owing to the escape of the arachnoid fluid the drainage tube opening did not close. The baby gradually grew weaker and died on the fourteenth day.

# EXCISIONS.

## METHOD OF MAKING INCISIONS IN PERFORMING EXCISIONS OF THE VARIOUS JOINTS.

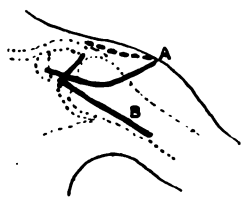



FIG. 136.

SHOULDER.

A.—Senn.

B.—Ollier.

WRIST.

C.—Ollier.

D. and F.—Lister.

E.—Von Langenbeck.

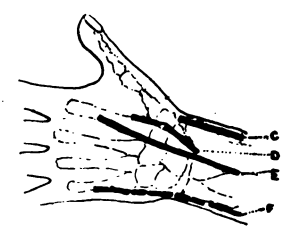



FIG. 137.

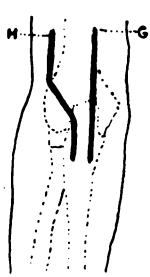



FIG. 138.

ELBOW.

G.—Langenbeck.

H.—Ollier.

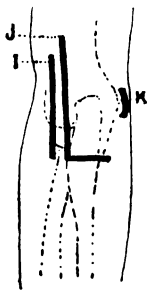
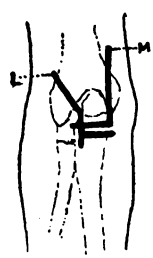



FIG. 139.

I. and K.—Hueter.

J. Nelaton.




L.—External Incision.

M.—Von Mosetig-Moorhof.

FIG. 140.

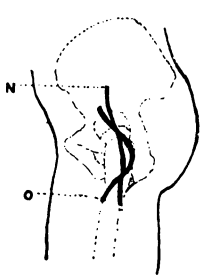
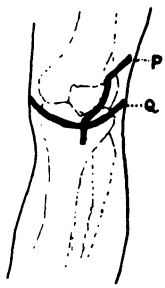



FIG. 141.

HIP.

N.—Ollier.

O.—Sayre.




KNEE.

P.—Ollier.

Q.—Semilunar.

FIG. 142.

FOOT.

R.—Mikrelicy.

S.—

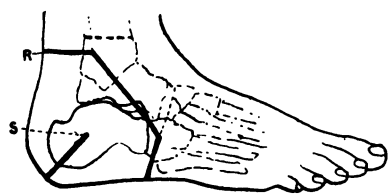



FIG. 143.

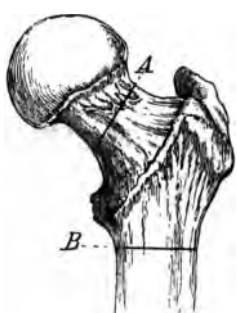



FIG. 144.

Buchanan's excision of sacroiliac joint.

OSTEOTOMIES AT HIP.

A.—Adams.

B.—Gant.

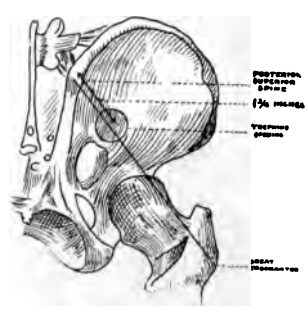


FIG. 145.

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